DISCOVERY

A Monthly Popular Journal of Knowledge

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Notes of the Month.

England still conceals beneath the surface of her soil an almost unlimited supply of archæological material; and while much sterling work has been and is being done by trained excavators, it may be said that almost anyone digging a hole in the ground may light upon some discovery of first-class importance. Such indeed appears to be the discovery, lately made in a Suffolk brickfield, of three subterranean shafts. So far it is impossible to say to what period the shafts are to be assigned; excavation was difficult and costly, and could not be carried to a conclusion; and practically no archæological material was forthcoming. The proximity of a Roman burial-ground makes it feasible that they were of Roman origin, and nothing in their structure precludes this. Some form of timbering must have been used in sinking the shaft, the walls appear to have been smoothed with a wooden tool, and a "false bottom" of clay had been constructed, probably to discourage investigators from probing to the bottom of the shafts. Increasing unsafeness, an inrush of water, and lack of funds have held up operations for the time being; but it is hoped that the shafts may yield their secret before the field is built over.

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The St. Albans and Hertfordshire Archæological Society is eagerly awaiting the report of Dr. Norman Davey, who has been exploring a Roman cemetery near St. Stephen's Church, south-west of St. Albans. In this case a great part of the site is actually built over, but by the goodwill of a resident access was obtained to one part of it. A considerable quantity of pottery was unearthed, showing the development of styles up to c. 160 A.D. Meanwhile, investigation of a much older group of sites is reported by the Brighton and Hove Archæological Society. This dealt with two village sites of the Late Bronze Age, to the north-west of Lewes, and has been described in detail in *Antiquity* by Mr. G. A. Holleyman, one of the principal excavators on the site. The lynchets found on the earlier site here (c. 1000-750 B.C.) are the earliest so far dated in Britain. The coming season promises great things for the English excavator, and we hope from time to time to record interesting advances in the archæological field.

* * * *

A series of regional guide books to the ancient monuments in the charge of the Office of Works has been planned by the First Commissioner of Works. These handy volumes will give, in a very convenient and attractive form, a general introduction to the archæology and architecture of important historical remains in each area from prehistoric times onwards, as well as brief notes about each monument arranged according to counties, with information as to situation, hours of opening and admission fees. The first volume in the series, written by the Rt. Hon. W. Ormsby-Gore, M.P., is now published (H.M. Stationery Office. 1s.; post free 1s. 2d.). It covers the North of England from the Scottish border to the southern boundaries of Lancashire and Yorkshire.

* * * *

The Office of Works certainly has a great deal of good work to its credit, but the comparatively short list of monuments in its care, in a region so rich in monuments, shows how much more there is to do. Mr. Ormsby-Gore's brief but allusive notes tempt one to explore further, and many readers will be glad of the short

bibliography at the end. The illustrations vary in merit, the reproduction being not always worthy of the subject depicted. This most welcome handbook is well bound in cloth and contains a sketch map of the area showing the position of the monuments and the main roads.

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The Council of the Physical Society has awarded the thirteenth Duddell Medal to Dr. C. V. Drysdale, who is distinguished for his outstanding work in connection with electrical and optical instruments. This medal is awarded to "persons who have contributed to the advancement of knowledge by the invention or design of scientific instruments, or by the discovery of materials used in their construction." Dr. Drysdale's improvements to electric and optical instruments date back to the beginning of the century; in 1901, for example, he was responsible for the design of the first accurate single-phase standard wattmeters, while the same year saw his design for the first large-aperture prism binoculars. He has been President of the Optical Society and examiner to the Spectacle-Makers' Company, at the same time carrying on his work on electrical testing machinery, dynamometers, potentiometers, and galvanometers.

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In *Johannes de Mirfeld*, shortly to be published by the Cambridge University Press, Sir Percival Hartley and Mr. H. R. Aldridge present a selection, with a translation, from the works of Mirfeld, a resident in the monastery of St. Bartholomew in Smithfield late in the 14th century. These are the first medical writings known to be associated with any English hospital. Although they are (as was customary) nearly always taken from older authority, they represent the state of medical knowledge in London some five centuries ago. Mingled with the accepted accounts of diseases and remedies are a number of charms and even some examples of pure magic. The editors also transcribe an account of the making of gunpowder and a note on weights and measures. Sir Percival Hartley is Consulting Physician to St. Bartholomew's Hospital and Mr. H. R. Aldridge is Assistant Keeper of Manuscripts in the British Museum.

* * * *

In the dearth of evidence relating to the earlier phases of the Stone Age in China, special importance attaches to the finds of a Mesolithic culture from caves in Kwangsi Province, in Southern China, which were examined by a party of geologists of the Geological Survey of China under P. Teilhard de Chardin and Dr. W. C. Pei, who discovered the first known skull of Peking Man. The artefacts consist of grinding stones, scrapers, perforated stones, and weights, with two fragments of antler. One grinding stone is elaborately decorated by incised lines on one side and one implement is a re-used palæolith. The technique of the perforated stones is remarkable in that the perforation is made by pitting and not drilling. The industry is said to resemble the "Bacsonian" (early Neolithic) of the neighbouring Indo-China, but appears to be earlier.

* * * *

The British Union of Practical Psychologists have produced (Feb., 1936) the first number of their new monthly journal, the *Practical Psychology Magazine*. The editorial modestly states that "we are only now beginning to understand something of the power of the mind and the creative capacity of its processes," and the magazine is the printed expression of a genuine effort to correlate such knowledge of the mind as we have with matters of everyday life. No. 1 includes cogent articles by Dr. Sloan Chesser and Dr. Hopewell-Ash, as well as a list of Club reports, arguing that the cause of practical psychology is very much alive in the provinces as well as in London. Professor Julian Huxley has justly condemned the prevalent unscientific application of such science as we have; it should be an important function of the practical psychologists to look to the better direction of the mass of knowledge at mankind's disposal to-day. The price of the magazine is 4d., the annual subscription 5s.

* * * *

Ignorance of business conditions generally and inability to adapt themselves to the rough-and-tumble of business life are among the principal allegations raised against public school men in commerce. The Public Schools' Business Society, now in process of establishment, is designed to remove all suspicion of inefficiency from the public school man, as such, embarking on a business career. In its prospective premises members will have the opportunity of hearing authoritative addresses on business principles, and of interchanging ideas with men in different branches of commerce; information will be available on suitable accommodation, on facilities for domestic needs, from sock-darning upwards, and on opportunities for specialised study. All public school men are eligible; the subscription is 21s. per annum; and full particulars can be obtained from the Hon. Organising Secretary, Kenneth Hare-Scott, 12, Cranley Gardens, London, S.W.7.

The Wandering of the Continents.

By M. H. Haddock, F.G.S., A.M.I.M.E.

Principal of the Coalville Mining and Technical Institute.

The Presidential Address at last year's meeting of the British Association attracted attention to the theory of Continental Drift. Mr. Haddock, who has studied the question from the viewpoint of the mining engineer, here discusses the evidence that suggested the theory and deals with the surprisingly delicate instruments that are now used to measure the normal movements of land.

THE late German geophysicist, Dr. Alfred Wegener, devoted the greater portion of his life to the investigation of phenomena, the existence of which must have been suspected by many observers of the earth's surface configuration since the dawn of exact cartography. These phenomena give rise to the substantially verified fact that the earth's land surfaces constitute an enormous disjointed jigsaw puzzle, the interlocking or fitting portions of which have floated away from one another. This conspicuous feature of the world's outer mantle is known popularly as "Continental Drift."

Even in our tenderest years many of us have been struck by the remarkable similarity in the continental features, especially in the Southern Hemisphere. Mark the South-Polar-directed apices of the great land masses like South America, South Africa, India, and Australia with Tasmania. Moreover, note the fractured wedge tip in each case: South America has the Falklands, South Africa has Madagascar, India has Ceylon, and Australia has New Zealand. And again, note that these detached spearheads, so to speak, are all disposed on the eastern sides of their respective wedges. Again, compare the mid-world land attenuations such as Central America and the old East Indies land bridge to North Australia, and note at the same time that the Adriatic Sea, Red Sea, and the Sea of Marmora are continuations of the Great Rift Valley fractures forming the famous mid-African lakes. Surely these uniform data cannot be fortuitous; not the outcome of some coincident whims on the part of Nature. Prehistoric legendary fable is not silent on this matter of floating lands, as Greek mythology testifies, and we have long passed the age when myth and fable were regarded as entirely human invention.

The Evidence of Zoology.

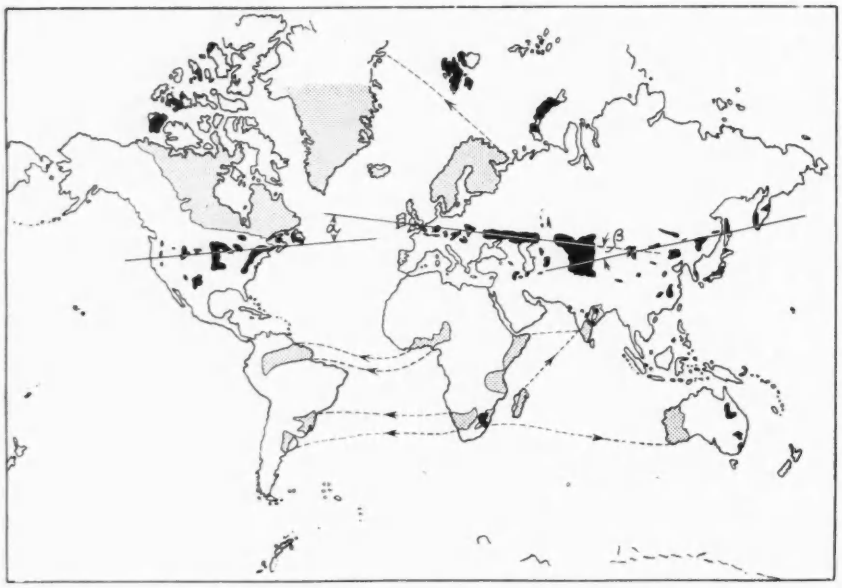
Hundreds of researchers in divers branches of science, each plying his particular tool, have contributed to verifying the fact that the continents actually move, either apart, or towards one another. The zoologist and palæontologist have contributed their quotas to this problem. Thus the puzzling problem of persistent and similar orders and species of invertebrates on either side of the Atlantic has been cleared up. It is well known that snails, worms, molluscs, etc., the modern representatives of one of the oldest forms of life on this planet, have never, in all their long geological history, shown evidence of more than merely local mobility. Indeed, many of them are permanently anchored and those that wander as parasites would never be able to give the astonishingly accurate and full reproductions of all their kind which we now find separated by major seas. We can only correlate the observed data by assuming that the earth's upper surface "floats."

The Tale of the Coal Belt.

Geological evidence is by no means lacking to support the theory of continent drift, even though the lack of alignment in disrupted members was long the cause of meagre support for the hypothesis. This lack of alignment, or force-trend direction, will be seen when we compare the movements of the igneous masses marked with shading in the first map herewith. Igneous masses, being irregular in extent and origin, can barely be accepted as geological disproof of the hypothesis, and the agreement is more than hopeful to those acquainted with the facts of all the forces in action at once or successively. More convincing is a study of the sedimentary rocks, especially of the Carboniferous coal belt of Europe, which, for reasons to be discussed, may be regarded as the great Europe-cum-Asia coal belt. Note that the Asiatic belt, like that of Europe and its prolongation in America, is in the temperate zone. All the U.S.S.R. coalfields are relatively low in latitude if we except two small fields on the Petchora and Lake Ladoga. The Spitsbergen and Novaia Zemlia fields are allied to the high latitude Canadian fields—a real Arctic suite, as anyone who bends the sheet to resemble a sphere will see. Moreover we are discussing only Carboniferous coals, *i.e.*, coals formed in measures long antedating the initial fracturing of the great land masses. Indeed, these measures of strata have been more investigated than any other of the earth's stratified rocks, since we are all agreed that coal, particularly the high carbon coal of the Carboniferous system, is to

be regarded as the life stream of civilised nations. Other geological assistance will be found in the fact that big mountain chains which suddenly, for no apparent reason, end at the sea, find their continuation overseas, as the Pyrenees do in North America. Again, in support of the issue, note that the "waisting" of Central America and Hither India cannot be accounted for by centrifugal force alone, as this would tend, were it alone operative, to mass the continental blocks in the torrid zone. Neither can we account for the long American backbone, extending from Nome to Tierra del Fuego and even into Antarctica, as being due solely to the pole-to-pole fracture that one normally expects on an internally hot ball subjected to external cooling. Obviously, were this feature alone the cause, the other continents would be like structures, whereas we know that the greatest chain of mountains, with the Pamir and other supreme plateaux, lies roughly at right angles to the American backbone. In both cases the greatest present-day factor in the creation of these vast uplands is continental drift.

Wegener[1] after an exhaustive study of the undisturbed, subsequently-deposited strata, *i.e.*, the younger or uppermost strata laid down after the period of fracture and "float-off," was able to place, in time, the period in the earth's sedimentary history when the fracturing commenced, that is to say when South America fitted into Africa; when India and the East Indies were not separated from South Africa; and when the land masses of Australasia were much nearer the earth's nether pole. At the same or a more recent period, Greenland, Newfoundland, Iceland, and the British Isles were formed as detached remnants of the North American mainland. For this we have igneous evidence, just as the rocks of the Deccan of India are correlatable with those of Southern Africa; and to localise the matter nearer home we would ask the reader to compare, on any suitable geological sheet, the Scandinavia—Scotland—N.W. Ireland "solid" structure and the general geographic and tectonic features. Wegener and his co-worker Köppen[2] arrived at the conclusion that the initial movement, apart of the continental masses *as we know them* (not the ultimate start of land-wandering, since the thinner the shell the greater the scumlike continents will move) took place during the Cretaceous or Chalk Age and developed much between the Eocene and Quaternary periods. The first drift was that of South America westward from Africa, giving us the ever-widening Atlantic rift, which is now known to be over 9 miles deep in places. The liberation of Antarctica, Australasia, and the East Indies took place later in the Cretaceous Age and developed the feature of splitting off individual blocks which drifted laterally. Thus the East Indies went to the north and are still moving north, causing the damming or urging up of the great mass we call the Himalayan Range; just as the earlier drift of South America is puckering up the great American backbone. Thus we see that the meagre foreshored lands west of this chain are not caused entirely by climatic agencies. It was formerly thought that the laden clouds, which had a most prevalent eastward trend, deposited their



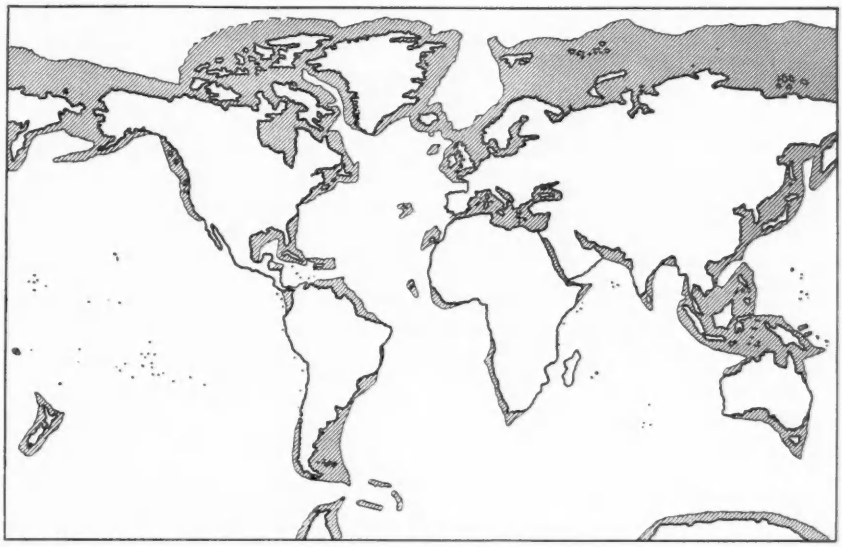
The relations between the great mid-latitude Carboniferous Coalfields of the world. Igneous masses are here shaded, coalfields coloured black.

[1] *The Origin of Continents and Oceans.*

[2] *Die Klimate der geologischen Vorzeit*, p. 79.

burdens on meeting these heights, thus denuding the western slopes and blessing the eastern sides with rich pampas and savannahs in the south and prairies in the north This agent we now know to be only a partial one, as also is that due to the axial movement of the earth

Let us consider the causes of this movement. We know that in addition to its axial and orbital movements the earth partakes of some four or five additional major motions, among which we find those known to navigators as precession and nutation. Now the sun and moon exert a pulling action on the earth, so constraining it to its orbital path and producing tidal and allied phenomena. This pull of the sun would be uniform were the earth a uniform sphere, but the attraction itself sets up equatorial bulge, causing oblateness of the earth, *i.e.*, lack of sphericity or polar flattening, a tendency which any plastic body spinning about a definite axis exhibits. Now the actual bearing axis of the earth does not coincide quite with its polar or rotational axis. This is due to various agencies: air and sea disturbances, varying loading of the crust by depositions, such as rain, and especially snow; also by the melting of ice and changing ranges of vegetation. All these are not uniform. They, together with the frictional, or slowing down, action of the tides on the earth, cause precession or movement in a different direction from that of rotation or revolution. Any body spinning under the influence of three forces exhibits precession. Let us consider a pretty example. Take a bicycle wheel and hold it erect before the body by means of an axle through the hub held in the left hand. Now spin the wheel with the right hand, and it will be noticed that the whole wheel actually traverses round the entire body of the experimenter until it comes to rest in the plane of the true north, the axial pole line mentioned above. The weight is noticed to lessen on the left or supporting hand, and if the speed of the wheel were very great it would actually rise, defying the third force, gravitation. These facts cause gyro-planes to function, and make obscured three-dimensional navigation, such as aeroplane voyages in high mists, or deep submarine passages, possible. Now one reason for dwelling on precession is because it has recently been discovered that the continental masses *as such* actually precess. Professor Schweydar[3], the eminent geophysicist, has computed that continental precession 30° either side of the equator is more than 200 times greater than the axial precession of the earth as a whole. Moreover, the endeavour of the continents themselves to rotate is generally in a different direction from that of the poles of the earth, so setting up meridianal directed forces acting westward. These forces are greatest at the equator, and dwindle to nil in latitude 36° north or south.



The continental masses and continental shelves (shaded); after Wegener and Born.

Measuring the Drift.

Let us now regard the actual measurement of this continental drift. It will be clear that no measurements confined to the earth alone will meet the case, any more that we can gauge the speed of a train by observations only in the train. We must look outside. Consequently, exact stellar observations and measurements must be resorted to. This is now possible in some 70 radio-receiving observatories all round the earth. Each of these observatories is equipped, not only with exact

[3] SCHWEYDAR. *Zeit d. Ges. f. Erdk.* (Berlin, 1921), p. 123.

reading and registering astronomical telescopes, but a radio detector, which enables the specialist to learn at once which station is transmitting. Extraordinarily precise time-recording is required. The world's most recent and most exact clock is to be found in the small observing laboratories on the Brauhausberg, near Potsdam. It is a quartz pendulum clock capable of varying only one second in 1,000 years. Now begins an era of unexampled precision. A star is observed in Potsdam and at the same time in Honolulu or Greenland. The course is read and registered and the time radio-communicated to all world observatories simultaneously. Precise conditions of atmospheric temperature and pressure are maintained to help ensure exactness.

South America Receding.

Now, if Potsdam and Honolulu were always at the same distance apart, fixed objects like the stellar bodies would always show the same time-intervals in their transits or in their angular distances when reduced to time by the well-known longitude transposition for hours. But the passage of the stars varies and this we have said cannot be due to the altering positions of the stars—it must then be due to our own positions altering. Honolulu is diverging from Europe. The reception, registration, and transmission are so exact that the distant observer can tell, by visual registration, which of the two small observatory laboratories in Potsdam (which are only a few meters apart), is in communication with him. The results of all the 70 observatories are sent regularly to the Paris Central Committee for International Longitude Measurement. The results are tabulated, " weighted," and compared ; and the astounding fact emerges that the distance between Washington and Paris increases by some 30 cm. (about 12 inches) yearly. Not much, but enough to establish the issue—more than 50 feet in the life of the Atlantic cable. Wegener has calculated the duration of " float-off " for South America to be about 30,000,000 years at a velocity of about 9 inches per year. On the other hand Madagascar floats away from South Africa at the rate of 9 metres, or nearly 30 feet, yearly, while present measurements show Greenland to be increasing its distance from Scotland by the large amount of about 60 feet per annum. The drift between North America and Europe is, on the whole, the most recent, and has been in operation for only 70-80,000 years.

Wegener and his school called the heavy substratum or basaltic masses of the earth's outer-mantle-but-one, the *sima*. The word is got from the first letters of the minerals silica and magnesium, the dominant components of this under-surface into which the great mountain masses dip like the roots of teeth. The floating surface is called the *sial*, since this higher mass is made up largely of silica and aluminium.

The earth is constantly moving up or down as a result of geological and seismic forces. We know, for instance, from observed data that if the Baltic Sea floor continues its uplift at its present rate, it will, within a million years, tower above the height of Everest. London's high-water level, on the other hand, is 15 feet lower now from what it was only as comparatively recently as the Roman occupation, so that if the depressional rate continues uniformly London is as doomed as inland New Orleans within 80 thousand years. But these movements are not our immediate concern and are cited merely to illustrate the irresistible nature of earth forces. Continental drift is not nearly so localised as earth movements of the above type. It is world-wide as can be gleaned by studying the appended map of the continental shelf, taken from Born's work.[4] This shelf is the sloping foreshore (if any) out to a depth of about 700-1,200 feet. The lateral extent of the continental shelf from the land, and its steepness, condition the seismic disquiet of a country. Note in the map that where this shelf is narrow or absent we have the places of seismic upheaval on the earth. Two-thirds of the active volcanoes of historic times exist here, as also 90 per cent. of the known subterranean ones. Continental drift, we say, conditions the steepness of the shelf flanks and, therefore, facilitates the transmission of submarine shocks to the land. Only where high land meets deep seas or near high mountains do we get volcanoes and earthquakes. The Antarctic vents of Erebus and Terror exist on high land near a sea 2 miles deep. Enough has been said to show that the fact of continental wandering is fundamental and has in the ultimate end been a deciding factor in many major forces affecting man, such as the old and perhaps not fabulous land bridges to N. America and Australia. Perhaps also the old lost lands of Atlantis and Lemuria may now be accounted for. It is, at any rate, certain that these continental movements have conditioned the wanderings of plants and animals and the tenability or otherwise of existing lands.

Modern Government.

Sir Ernest Benn's new work, *Modern Government*, is to be published by George Allen & Unwin, Limited, on March 10th, and booksellers are now in a position to take orders for the first edition.

[4] Born. *Development of the Geological Form of the Earth* (Berlin).

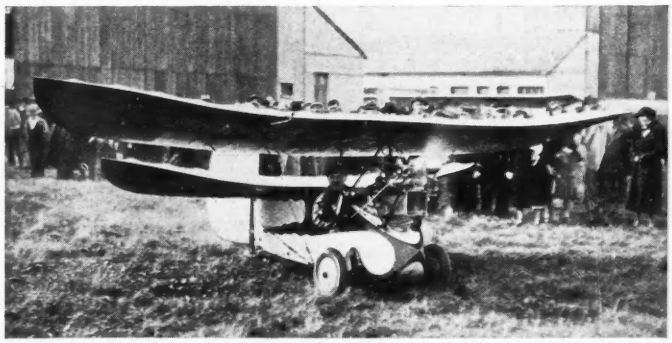
Light Aeroplanes.

By J. L. Nayler, M.A., F.R.Ae.S.,

Secretary of the Aeronautical Research Committee.

The invention of the "Flying Flea" or "Pou du Ciel" seems to bring within calculable distance the day when every man may have his own aeroplane. The modern small aeroplane is not without its disadvantages, however, and Mr. Nayler, with his wide experience of all types, can show just where improvements are most essential.

EVER since man began to fly it has been his aim to make flying possible for everyone. The idea of travelling through the air instead of on the surface of the earth has even now the fascination of novelty for many, but behind it still more lies the almost universal desire to save time in travelling from place to place. It is now possible to fly from almost any one place to any other on the earth's surface, but it is a costly business and moreover the flight has to start from one of a certain quite limited number of places and end likewise at a recognised aerodrome. To get over these difficulties it is necessary in the first instance to have a small and cheap aeroplane or aircraft, and also one which can safely be taken off and landed in a relatively small area such as a field. The autogiro has shown promise of fulfilling some of these needs but there are certain complications in its construction and a less economical operation which we do not propose to go into here, but which have driven man to look again at the possibilities of the small light aeroplane for everday use. We find in this country machines such as the B.A.C. "Drone" which has been used a little for what has been called "aerial tobogganing"; in Germany attempts have also been made with similar glider types of structure fitted with a small engine; in France a new machine with a very small engine has just recently come into prominence called the *Pou du Ciel* or "Flying Flea"; in U.S.A. the Bureau of Air Commerce are encouraging the production of a light aeroplane which shall also be safe in flight and the Weick W.1 is typical of the results that are being achieved.



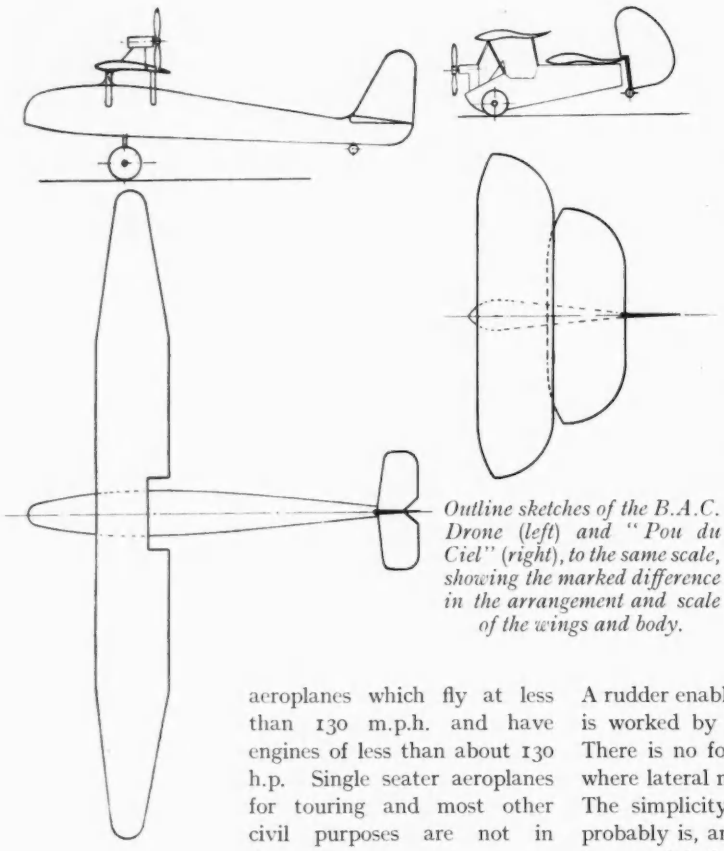
M. Henri Mignet in his latest "Pou du Ciel," with three-cylinder, 28 h.p. two-stroke Aubier-Dunne engine.

[By Courtesy of the Editor of "Flight."

In view of these renewed efforts to make flying possible for all, it is of interest to look back at what has previously been accomplished in this direction. Small aeroplanes fitted with small engines are by no means new. The Wrights only had small engines. Blériot flew the English Channel in 1909 with an engine no more powerful than that fitted to some of the 400 home-made *Poux du Ciel* which exist in France to-day. These pre-war aeroplanes were not, however, as safe as the normal aeroplane of to-day, and, in addition, although they landed at a low speed, about the same as the 35 to 40 m.p.h. demanded by the U.S.A. to-day, they had a top speed which was only a few miles an hour greater. These aeroplane types were succeeded by others whose horse power increased rapidly each year until an attempt was made in 1923 and 1924 in Great Britain to stimulate the production of light aeroplanes by the offer of prizes.

The light aeroplane competition of these years produced the single seater Wren, which with a 3½ h.p. A.B.C. motor cycle engine was flown for long distances round a closed circuit and covered 87.5 miles to the gallon. Larger light aeroplanes were fitted with Bristol Cherub motors of 35 h.p. and attained top speeds up to 80 m.p.h. The experience gained at these meetings demonstrated that flying could be made cheap and safe enough to attract the private individual of moderate means. It was, however, clear that the engines had not enough power for safe touring in bad weather conditions and that they ran too fast for reliability, for length of life, and for general economy. The consequence was the development of aeroplanes with much higher powers such as the de Havilland "Moth" and the Avro "Avian" which have since

proved their general reliability on long tours and world flights. With the 90 h.p. of the Cirrus motor, the "Moth," carrying two persons, reached a speed of 90 m.p.h. which proved quite sufficient for general touring. Nevertheless, designers of light craft of this kind have continued to increase the horse power of the engine either to obtain higher speeds or to increase the carrying capacity beyond merely a seating accommodation for two persons, so that to-day few people tour by air in



Outline sketches of the B.A.C. Drone (left) and "Pou du Ciel" (right), to the same scale, showing the marked difference in the arrangement and scale of the wings and body.

aeroplanes which fly at less than 130 m.p.h. and have engines of less than about 130 h.p. Single seater aeroplanes for touring and most other civil purposes are not in demand.

History repeats itself and again there is a demand for an aeroplane with a much smaller engine, cheaper to buy and to maintain, easier to look after and capable of short flights under fairly good weather conditions. Amongst those at present being advertised, that most in the public eye is the *Pou du Ciel*, a few of which are being constructed and have flown in this country under the stimulus of the Air League. It is of special interest because it differs in many ways from its predecessors.

The *Pou du Ciel* is in the first instance easy to construct. We might almost say that anyone who is a good carpenter could make one. Amateurs in France make them from the rough sketches and dimensions given in the book published (both in French and English) by M. Henri Mignet.* The first two of those which were British built proved a source of irritation to their owners. One turned turtle in a cabbage-field and the other overturned on to one leg and a wing tip; but neither accident was serious. On the other hand, during the past summer M. Henri Mignet has made a tour of 1,200 miles in the North of France and another of 2,000 miles in the South of France in his own machine. These figures show the possibilities of the Flying Flea for aerial touring. Also it can be built more cheaply than any other aeroplane yet designed, and it has a low running cost because the twin cylinder two-stroke engine that is used is only 14 h.p. and consumes but 8 litres of fuel an hour.

The main lifting surfaces of the Flea are two tandem wings, one placed behind and below the other. The front wing has a span of 5 or 6 metres and the rear wing 4 metres. The total length is less than 4 metres. Flight upwards and downwards is controlled by a movement of the front plane pivoted on a small pylon and directly connected to the control stick. There are no ailerons for lateral control or balance, the stability in roll being obtained by the use of a large dihedral. A rudder enables the pilot to maintain his direction, and is worked by lateral movements of the control stick. There is no foot-rudder bar as in ordinary aeroplanes, where lateral movement of the stick works the ailerons. The simplicity of the controls is claimed to be, and probably is, an advantage up to a certain point, but it is essential that the machine is not overbanked on a turn, since there are no ailerons to correct this. For ordinary touring in good weather this is not of great importance, as the machine has good lateral stability. The main change is in the longitudinal control. The pilot moves the whole of the larger lifting surface and, on account of the direct control, he is able to feel gusts as soon as they strike the machine instead of waiting, as in the conventional aeroplane, until the gust strikes the tail. He can in a sense ride the wind as a man rides a horse. Here again, in good conditions, this type

* H. MIGNET, *The Flying Flea* (Sampson, Low 7*s*. 6*d*.)

of control may well prove adequate. If the machine is disturbed too far from the equilibrium condition, it is, however, doubtful whether a pilot can use sufficient force quickly enough to ensure recovery. Common practice since the days of the Wrights, who used front elevators, has insisted on the fore-and-aft control organ being placed behind the main surfaces.

What else is offered at present in the way of small aeroplanes ? The late Lowe-Wilde brought out a small very low-powered aeroplane a few years ago. It was used for joy-riding on and near aerodromes but not for cross country flights like the Flea. It consisted essentially of a small engine fitted to an efficient type of glider. Its successor is the B.A.C. " Drone." The engine, a 600 c.c. Douglas two-cylinder engine (14 h.p.), is mounted above the wing and drives a pusher airscrew, whereas the Flea has a tractor airscrew in front of the body. Both depend on a motor cycle engine but the landing speed of the " Drone " of 25 m.p.h. is a little higher than that of the Flea. The construction of the high monoplane wing is more complicated than the single spar wing of the Flea and the span is much greater, being 40 ft. 10 in. On this account and because it is a more finished product the cost of the " Drone " is probably double that of its rival. On the other hand, it is a conventional aeroplane in most respects and is therefore probably easier for the ordinary pilot to fly on that account.

The B.A.C. Super Drone in flight.

[*By Courtesy of the Editor of " Flight."*

The Moth Major.

[*By Courtesy of the Editor of " Flight."*

The requirements in the U.S.A. have been laid down in the first instance for a safe aeroplane with simplified control. The Weick W.1, the Stout Sky Car, the Aeronca, and others are all typical aeroplanes fitted with small engines of the opposed twin air-cooled type, but the tendency is to use a larger engine of the order of 35—40 h.p. These aeroplanes are designed with a limited elevator control, so that the pilot cannot pull the nose of his aeroplane up so quickly that he stalls it with the subsequent danger of a steep dive or a spin. The main reason for this is based on the conclusion reached in the U.S.A. that at least half of all the serious accidents are caused by stalling. Bad landing, especially across wind, is another difficulty that is partly met by the introduction, in the Weick and the Stout Car, of a three-wheel undercarriage, two wheels behind and one in front of the centre of gravity. The Weick and Hammond have, in addition, a control which is a combination of a slot and aileron. This is intended to obviate the need of a rudder and is the type that has been chosen for experiments in simplified control at the Langley Memorial Aeronautical Laboratory. Some of these aeroplanes are fitted also with flaps to help the pilot to come in more steeply to land.

All these aeroplanes are much larger in span than the Flea, and on this account less easy to handle but better for flying on a windy day. A main controlling factor in all flying is the take-off and landing conditions. Most birds fly at a loading of 1½ to 2½ lb. per sq. ft., but they can make a very rapid response to any irregularity of the wind near the ground. Man has not yet built an aeroplane that can compete with the bird in this way, so he has got over the difficulty by using the effect of inertia. With a loading of 5 to 6 pounds per sq. ft. a machine is much less liable to be tossed about near the

ground in a country such as Great Britain where gusty winds of 20 and 30 m.p.h. are so common. The "Drone" has a loading of less than four pounds per sq. ft. and is not easy to manoeuvre in bad weather. To fly with a loading of six pounds per sq. ft. means an engine of 50 to 60 h.p. Even the designer of the Flea is appreciating the need for more horse power, as it is now proposed to fit a larger engine, developing 27 h.p., to be produced by the Douglas Company. This is doubling the existing power. At the same time the extra horse power will give an increased top speed that will be most welcome when average head winds of, say, 20 m.p.h. are met and the possibility of running into 40 m.p.h. before reaching one's destination has to be borne in mind.

The increased engine size and weight and the higher speed mean a larger, stronger, and more expensive aeroplane. We come, in fact, to an aeroplane that is not as large as the D.H.60 "Moth Major" but more like the "Acronca," which weighs 1,066 lb. Indeed, we are compelled to return for normal safe flying to one of the recognised types of light aeroplane such as are used by the Light Aeroplane Clubs before we can be certain of flying with anything approaching the regularity of travel that we are accustomed to on the rail or the road. As for flying as a mere sport, it appears that there is no continued demand for it in this country, because there is too much sameness about it, as compared with any popular sport. What is needed is a machine to take you somewhere and back again. In fact, the two-seater "Moth Major," weighing 1,750 lb. with a range of speed from 42 to 112 m.p.h. and a four-cylinder 130 h.p. engine is typical of present-day requirements. It is expensive to fly and maintain in serviceable condition in comparison with the Flea, but its advantages are many: it has two seats instead of one, it has a speed nearly twice as high, its range greatly exceeds that of the Flea, and it has shown great reliability in service, having an engine of four cylinders instead of two.

The Machine of the Future.

The limitations of the future cannot be forecast with certainty. The ordinary wing has a lift co-efficient of about 0.6 to 0.7, but with slots and flaps this can be doubled. If we take it as essential to-day that the landing speed shall be 40 m.p.h. and, in view of our remarks about the average wind, that a machine shall have a top speed of 80 to 90 miles per hour, we can look forward to reducing the landing speed to 30 m.p.h. or alternatively to cutting down the area of the wings to half. This last does not lead to simplicity in flying, but it would enable the conventional type of aeroplane to be reduced nearly to the span of the Flea. Many aeroplanes can be flown without using the ailerons but the advantage of having them in an emergency cannot be overlooked. Cheapness of construction and maintenance can come only with engines which weigh much less per h.p.; and, to be made thoroughly trustworthy they should have at least four cylinders.

Spring Migration of Birds in Western England

By E. W. Hendy

THE investigations on this subject in 1934, which I described in DISCOVERY for March last, were continued in 1935 as to the same species, and the short summary herewith may be compared with the data then given. The following table shows the migration periods in the two years.

Species.	*Migration period*, 1934.	*Migration period*, 1935.
Wheatear.	March 19th to May 20th.	March 10th to May 19th.
Chiffchaff.	March 10th to May 21st.	March 11th or 12th to May 11th.
Swallow	March 29th to May 27th.	(One, March 4th) March 29th to May 28th.
Cuckoo.	March 22nd to May 6th or 7th.	April 7th to about May 12th.
Common Whitethroat	April 5th to 3rd or 4th weeks May.	April 12th to May 15th.
Spotted Flycatcher.	April 21st to 1st week June.	April 21st to June 8th or later.

As in 1934, these species generally arrived during spells of favourable weather. But some wheatears came in during fog or cold and against contrary winds; there were "waves" of swallows during bad periods in April, and a "rush" of cuckoos, April 19th to 23rd, during almost continuous bad weather in the Channel and in France. Swallows and cuckoos are strong fliers, but the "rushes" of such small birds as chiffchaffs and whitethroats, which occurred in heavy rain and against adverse winds, are remarkable.

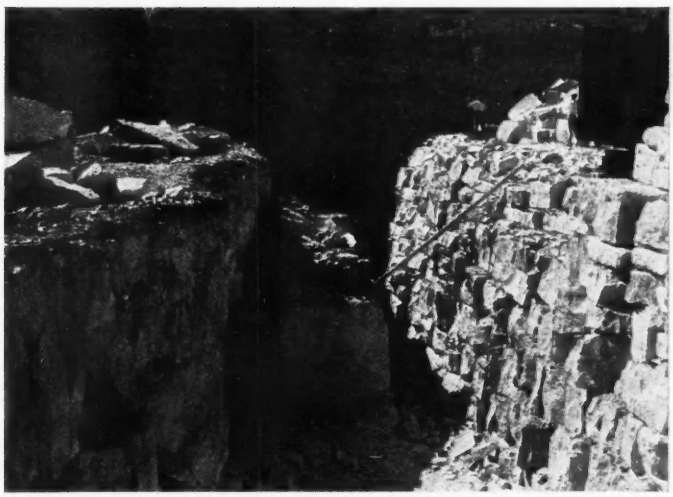
All the selected species, except the spotted flycatcher, used the "West Coast route," which passes along the north-west shores of Cornwall, Devon, and West Somerset; it may extend as far south as the Isles of Scilly, and possibly includes Lundy Island, where some swallows arrived from the south-west and flew east or north-east: other swallows left this route at Baggy Point and Morte Point (west of Ilfracombe) and flew north or west. Nearly all the river valleys on the South Cornwall and Devon coasts were used as migration routes, especially Tamar and Tavy, and Exe. Torquay was again a very favourite landing place, and there is considerable evidence of a passage from the South Devon coast to Dartmoor and Exmoor.

Purbeck and Portland

By Wilfrid McWilliam

Traditional modes of working are still in use in the famous old Dorset quarries of the Isle of Portland and the Isle of Purbeck. Just lately "sanctions" have stimulated the production of fine-quality English stone; but modern methods would appear essential to the quarries if they are to compete successfully with ferro-concrete.

THE stone industry in the "islands" of Purbeck and Portland is still controlled by the regulations of the oldest trade union in existence, the Marblers and Quarriers of Purbeck and Portland. Present-day competition, however, with the exponents of ferro-concrete construction has compelled the more advanced quarriers to modernise their methods. In one Portland quarry refuse stone is still removed by means of a hand-operated winch and bucket, while in another less than 400 yards away the same operation is carried out at fifty times the speed by an oil-driven excavator.



A quarry at Easton, typical of the larger Portland establishments. On the right hand side worked stones are stacked.

The actual work of quarrying is still done with the primitive type of axes used for the last 300 years, but it seems only a question of time before pneumatic drills and chisels are introduced to expedite the production of natural stone in prescribed shapes and sizes.

Visitors to Purbeck and Portland will immediately observe a marked difference between the methods adopted in the two districts. In Portland the quarries are all open to the sky, because the useless top layers of rubble and broken stone are first of all stripped off and hurled over the cliffs which form the western boundary of the island.

In Purbeck the soil of the fields is disturbed as little as possible, the stone being obtained by underground mining. A shaft is first of all driven into the earth to a depth of about 50 ft., at an angle of 45° to the vertical. From the bottom of this shaft horizontal workings are cut, and the stones, when obtained, are drawn up the incline by an ancient horse-driven windlass. Along the coast between Peveril Point and St. Aldhelm's Head, the stone-bearing seams are exposed in the cliff face, and in times gone by it was possible to quarry the stone without sinking a shaft. Most of these cliff quarries are now worked out. Primitive though Portland methods may be, Purbeck is still more old fashioned. Purbeck quarries are as a rule owned and worked by some half-dozen men only, and the use of engine power is rare. The right to enter upon any man's land and work the stone is still claimed by Purbeck Marblers, but the claim has not been conceded for a generation.

Purbeck marble has been known and worked for about 700 years. Most of it is grey in colour, but red and green varieties are sometimes met with. It was once much used for the slender shafts favoured by the builders of Gothic churches for ornamentation, but the introduction of foreign marbles has greatly affected the demand. The interior of the beautiful little church at Kingston, Dorset, is entirely of Purbeck marble, and there is hardly a building of any pretension to style in the South of England that does not owe some of its beauty in masons' work to Purbeck marble.

From a business point of view, the production of stone seems to be on a better footing in Portland than in Purbeck. The whole of the northern part of Portland is devoted to the industry, and instead of tiny quarries worked and owned by a few operatives, large tracts of land are opened up and worked systematically by limited companies with capital at command.

It is highly probable that the irregular distribution

of Purbeck stone at all depths and angles has prevented anything like a systematic exploitation of the Purbeck Hills. The violently contorted geological strata afford ocular evidence of this fundamental peculiarity of the Purbeck beds.

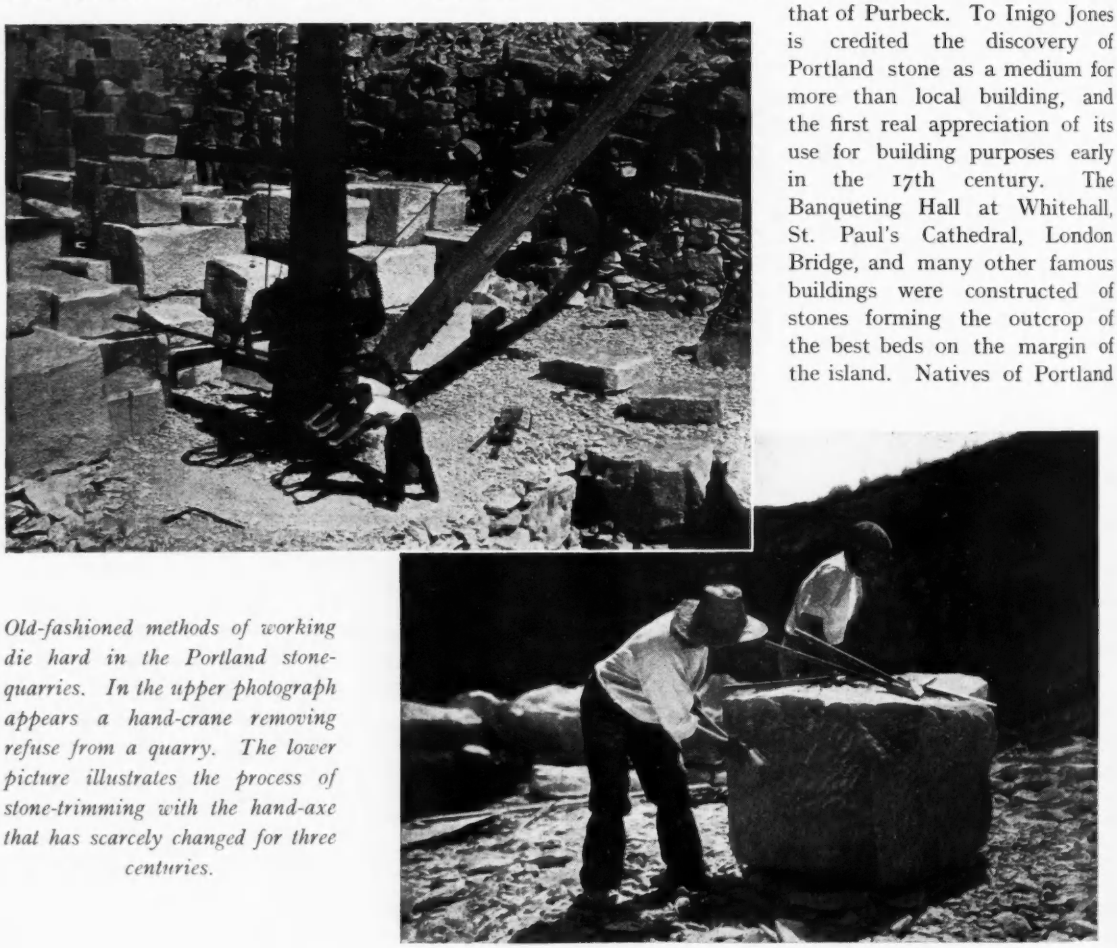
Portland stone, on the other hand, occurs in fairly regular formation of parallel layers at uniform depths. Careful borings at various places in Portland have established the existence of a regular sequence of stone beds at the following tabulated depths.

1 ft. 0 in. Soil.
10 ft. 0 in. Hard Limestone and Rubble.
7 ft. 0 in. Dirt Bed.
15 ft. 0 in. Top Cap.
8 ft. 0 in. Whit Bed.
6 ft. 0 in. Pericott.
9 ft. 0 in. Base Bed.
40 ft. 0 in. Limestone.
80 ft. 0 in. Portland Sand.

Of these the "Whit Bed" and the "Base Bed" provide the most valued stone for building, as they are regular in texture and cleavage, and soft enough for cutting to size. The top layer of limestone is too treacherous to work because of its tendency to split and fly. The "Dirt Bed," though useless for ordinary purposes, is interesting on account of the fossilised plants and trees found in it. Between the "Whit Bed" and "Base Bed" there is an irregular deposit of curf and flint, locally called "Pericott," in which occur many specimens of *Ammonites giganteus*. In a pleasant little "fossil garden," belonging to the chief quarry office in Portland can be seen complete upper and lower casts of an Ammonite, measuring 30 inches in diameter.

Both the "Rubble" and the "Dirt" beds are thrown away as useless. Capstone was used for filling up work on the Portland Breakwater, but as a rule it does not pay for transport from the quarries.

The Portland stone industry is not so ancient as that of Purbeck. To Inigo Jones is credited the discovery of Portland stone as a medium for more than local building, and the first real appreciation of its use for building purposes early in the 17th century. The Banqueting Hall at Whitehall, St. Paul's Cathedral, London Bridge, and many other famous buildings were constructed of stones forming the outcrop of the best beds on the margin of the island. Natives of Portland



Old-fashioned methods of working die hard in the Portland stone-quarries. In the upper photograph appears a hand-crane removing refuse from a quarry. The lower picture illustrates the process of stone-trimming with the hand-axe that has scarcely changed for three centuries.

say this stone was more durable than that at present quarried in the interior. Latterly, Portland stone has been employed for the Cenotaph in Whitehall, the new Bank of England, and the new University of London buildings.

For a long period the industry was in a flourishing condition. From the start of the building boom 100 years ago until the outbreak of war in 1914, there was a regular demand for Portland stone, both at home and abroad. The trade was not a seasonal one because it could be carried on in nearly all weathers, and the stones stored for delivery as required. Certainly the Portlanders are a healthy and hospitable race, the men often continuing to work in the quarries until the age of 70.

At present there is only three days' work per week for the quarrymen, and the output is half of what it might be. Buildings are run up with such rapidity in ferro-concrete that the demand for stylish designs in worked stone has suffered. It would seem that economies in working, in both the "islands," are necessary to meet the competition of the cement pourer. The introduction of modern mining machinery and improved transport methods are essential to preserve these interesting old industries from extinction.

A veteran Purbeck quarrier. The work is healthy and quarrymen still active at 70 are no uncommon sight.

Migrant Lepidoptera.

THE systematic study of the migration of the *Lepidoptera* is a modern development, requiring the collaboration of the greatest possible number of observers, many of whom will be surprised to know that the immigration of both butterflies and moths from overseas is not an exceptional, but a constant occurrence, though still but little understood. The mystery of many of our so-called "reputed" and rare species is now known to be due to immigration, as in such cases as the Bath White, Queen of Spain Fritillary, and Camberwell Beauty, among the rarities; and the Clouded Yellows, Red Admiral, and Small Tortoiseshell among the more familiar species.[1] Some are exclusively immigrant, while others, such as the three common whites, have their numbers reinforced from abroad, often in uncountable quantities. The Milkweed Butterfly even crosses the Atlantic from America, and the Painted Lady is one of the greatest migrants in the world.

Among the moths too there are many immigrants, but their nocturnal habits make them very difficult to observe. There is an immense field for research here. Of our seventeen hawk-moths, only eight are resident, and a considerable number of others, including Noctuids, like the familiar *Plusia gamma*, and Geometrids, are known to be immigrant.

A recent pamphlet[2] gives a brief account of all our known immigrant species, with five excellent coloured plates. There is enclosed a Standard Record Card and a memorandum issued by the Insect Immigration Committee of the South-Eastern Union of Scientific Societies.

All who take the slightest interest in such mysterious phenomena should take notice and record their observations, preferably on these record cards, and communicate their notes to the Keeper of Entomology at the Natural History Museum, Cromwell Road, S.W.7. Everybody living in the country ought to secure a copy of this booklet, and a copy should be given to every intelligent schoolboy.

[1] Cf. C. B. WILLIAMS, Sc. D., *Butterfly Immigrants in Britain* (Discovery, Feb. 1935).

[2] *British Immigrant Butterflies and Moths* (British Museum, Natural History Dept. 9*d*.).

Messrs. Jonathan Cape announce a new cheap 4s. 6d. edition of *Here and There with Birds*, by E. W. Hendy, whose ornithological studies are well known to our readers.

A Survey of Weather Recurrences.

By Reginald M. Lester, F.R.Met.Soc.

The most constant feature of weather recurrences seems, unluckily, to be their inconstancy. Mr. Lester, himself a meteorologist, has delved deep into the literature of the subject, and finds very little sure evidence. Scientific research is proceeding, however, and the projected Gulf Stream Research Station at Bermuda may lead to important discoveries concerning European weather cycles.*

WEATHER is a subject that seems to hold popular interest continuously and that gives rise to much controversy. However discouraging statistics may be, the widespread belief in a recurrence of weather cycles is firmly maintained. Meteorologists are still seeking for the perfect cycle in weather that would make accurate forecasting mere child's play, but although certain periodicities have been discovered to exist, they show such baffling changes in amplitude and phase as to be practically useless.

A number of people obstinately believe in a seven-day cycle, but the only support for this would appear to be in industrial areas where the power of man affects to a slight degree the order of Nature. For instance, in the Lancashire manufacturing town of Rochdale, the statistics show that on Sundays, when the mills are closed, the average rainfall is less than on any other day of the week. This suggests that the large volume of heated gases rising from the burning of hundreds of tons of coal a day in the numerous factories, give the required uplift to the atmosphere necessary for an increase of rain.

It will be seen, however, that a periodicity of this nature has no value for forecasting purposes. On the other hand, the semblance of a weekly cycle was discovered to exist in certain parts of the world, notably in Australia, where the rainfall showed marked periodicities of 7.2, 12.1, 16.4 and 31.2 days—four cycles per month.

Buchan Periods.

Another popular belief is that the weather changes with the monthly changes of the moon. It may do so upon occasion, but when it does it is mere coincidence, for there are no statistics to prove that there is any regular cycle of weather conditions corresponding to the monthly cycle of lunar phases.

Annual cycles of weather have gained still more persistent belief, especially the cold spells known as the "Buchan periods." Alexander Buchan accounted for these regular spells thus: "Deductions from all observations hitherto made show that there are certain periods, more or less well defined, when the temperature, instead of rising, remains stationary or retrogrades, or instead of falling, stops in its downwards course, or even rises, and at other times falls or rises respectively for a few days at a more accelerated speed than usual."

Many newspapers still lead the public to think that these periods apply to London and the south of England, whereas they were actually deduced by Buchan from observations in Scotland, and intended to apply to that country alone. The only periods when Buchan's spells appear to be at all true in London and the south are his cold wave of February 7th to 14th, and the hot wave from July 12th to 15th. (The latter is very marked in most years.)

Brückner Cycles.

There is perhaps a little more foundation for certain long-period cycles, the most outstanding of which is the well-known Brückner cycle of thirty-five years. Dr. Eduard Brückner, when Professor of Geography at Berlin, made a remarkably detailed study and analysis of records of rainfall, temperature, and pressure over a very long period of years, and between the years 1020 and 1890 he discovered twenty-five cycles of an average length of 34.8 years each. The intervening cycles varied between 20 and 50 years, and consequently this variation makes it impossible to use the Brückner cycle for any regular long-distance forecasts. It is true that it has worked out with a great degree of accuracy this century, in view of the 34 years' interval between the severe winters of 1895 and 1929, but it gives no foundation for promising a succeeding cycle without a variation break. It seems probable that there may be a marked periodicity of temperature or of rainfall at about these intervals, but the influence of disturbing factors intervening continues to throw out these otherwise fairly regular cycles, and until the cause and origin of such "accidents" can be discovered, no considerable advances in long-range forecasting can be expected.

Brückner's own words, when referring to his extensive investigations, describe the whole situation so aptly that they are worth recording here. He wrote: "I have attempted to sketch a picture of the climatic variations through which our earth has passed in the last centuries. Like the wheels of a clock the different meteorological elements engage with one another. We see the wheels turn and the hands move in predetermined rhythm, but the driving force of the spring is hidden from us. We can only recognise its effect and infer from it the powerful strength of the force. It raises the levels of the lakes,

* See DISCOVERY, December, 1935, p. 372.

the rivers, even the sea itself; it pushes forward the glaciers and hastens the ripening of the plants. It goes deep to the root of human life, for it greatly influences traffic, husbandry, and health, and even repeats itself in theories and scientific observations. Only, itself, the cause of the climatic changes, we do not know."

Another long-period cycle was supposed to have been found by the late Dr. C. Easton, who investigated data back to the year 760. He found evidence of a 89-year cycle of winter severity, with a well marked half-cycle of 44½ years. Within each interval of 44½ years, from 760, it was proved that the first half has been colder than the second, with no exceptions to the rule since the year 1200. Also, within each space of 89 years, the first half has been colder than the second with only one exception since the year 1116.

For the last two centuries there has been a rather pronounced cycle of 50 years of groups of wet and dry summers and winters, lasting from five to eight years each group, the four recurrences since 1741 being decidedly regular.

The Influence of Sunspots.

A cycle that has received considerable prominence is the eleven-year sunspot cycle. The average length of these periods is 11.125 years, or—what is still more accurate—the double cycle of sunspot activity is 22.25 years. This waxing and waning of sunspot activity can be used to forecast variations of solar radiation, but the cause of the cycle is still unknown. That these sunspot cycles have any relation to terrestrial phenomena is not borne out by statistics, except that they are often followed by fluctuations in the elements and by variations in the frequency of the auroræ. They certainly have no bearing upon periods of drought or frost. The only part of the world where there does seem to be some relation between sunspot activity and rainfall is the plateau of Lake Victoria, in equatorial Africa, where the rainfall rises and falls with the rise and fall of solar activity, every eleven years. This has been investigated and confirmed by the London Meteorological Office. It will be seen, therefore, that although certain elements of the weather may be governed by solar activity near the equator, any such influences are lost on their way through ocean currents, winds, and so on, before they reach the temperate zones. Consequently, sunspot cycles are of no importance in relation to the weather over Great Britain.

The various eleven-year periodicities that have been found to exist to a certain extent in some parts of the British Isles have therefore no connection with the sunspot cycle of the same period. Alexander Buchan discovered a period of 11 years between heavy rainfalls at Rothesay, in Bute, and certain other mountainous regions in the Western Highlands. This increased rainfall appeared to be due to a periodicity of south-westerly wind frequencies, which occurred in these districts every eleven years. The well-known scientist, Brunt, discovered a periodicity of 11.4 years in the temperature of Edinburgh, but stated that "no obvious relationship can be discovered between temperature in individual years and the phase of the sunspot variation."

Dr. C. E. P. Brooks, in 1928, examined the relation between sunspots and the distribution of pressure, as a result of which he pronounced that "the variations of sunspots in the eleven-year cycle cannot be taken into account in predicting quarterly mean deviations of pressure in the North Atlantic or western Europe."

Shorter period cycles of rainfall are evident in certain parts of the world—particularly the East Indies—and rainfall can be forecasted with considerable accuracy in these countries for many months ahead. A 3½-year cycle of rainfall has been suggested as applying to Great Britain, but although this has been established on several occasions, it has suddenly broken down just when a spectacular development seemed to have been reached.

There are, however, local weather cycles in this country, applying to small areas only, the most notable of these being the 5.1-year recurrence of cold winds at Southport, Lancs., and the 3.1-year cycle of rainfall at Oxford. There also seems some evidence to support a general 2.85-year weather cycle in parts of Lancashire. Some years ago it was believed that a cycle of 3.995 years had been discovered in London's weather, but although this continued with remarkable accuracy for several months, it suddenly broke down completely.

Wet and Dry Years.

There seems to be some justification for serious consideration of a series of two-year and three-year oscillations of weather—so far as rainfall is concerned—in the southern half of England. From 1889 to 1909 every third year was remarkably wet, and—with the exception of one normal year—all the intervening years were decidedly dry. From 1909 the sequence suddenly changed to a two-year oscillation, and all the even years till 1922 were much wetter than the odd years. After 1922, the two-year sequence changed back again to the three-year one.

About twenty years ago Sir Napier Shaw found a periodicity in the yield of wheat for eastern England from 1885 onwards, of 2.75, 3.7, and 11 years (the two shorter periods being fractions of 11 years), but after 1908 these cycles broke down like the rest.

In The Washington Monthly Weather Review some years ago, two rainfall periodicities of about 10 and 15½

years were examined, and found to exist over a period of 173 years in northern Europe. Rainfall data in the British Isles were also investigated from 1834 to 1924, and the most outstanding periodicities proved to be 24½, 41 and 51 years, all of which are sub-multiples of a major cycle of 613 years.

Some of our Colonies seem to offer safer scope for accurate forecasting, and evidence has been discovered fairly recently of a four-year cycle in Australia, in rainfall and temperature. One should add, however, that the general rainfall values in Australian records have been kept over too short a period to enable the cycle specified to be tested with sufficient confidence against the risk of its breaking down when it comes to be tried out over a longer period.

Days when it never Rains.

A very interesting and useful investigation was carried out from 1930 to 1933 by Mr. D. Dewar, B.Sc., of the statistical probability of the recurrence of rain in London on given days in the year, and at given times of these particular days. The summary of this investigation brings to light some astonishing facts. Over a period of fifty years, the statistics prove that rain has never fallen in London during the morning of March 16th or the evening of October 3rd, and that the same fine period has been regularly experienced on the evening of every May 18th and the early mornings of May 9th and 16th. Other "all fine" periods during this 50-year investigation are June 13th (early morning) and July 3rd (evening). At the other end of the scale, there is no "All-wet" period, the worst throughout the 50 years being on the average only wet twice out of five times.

The periods August 21st—31st and October 21st—31st have an outstandingly high probability of heavy rain in the afternoon, the former probably being due to the prevalence of thunderstorms, which reach their maximum activity about that time of year. The lowest frequency of heavy rain occurs from April 11th to 20th and the highest from October 21st to 31st. Taking the mean for the whole month, May is lowest with a 1 in 4 frequency of heavy rain, and December highest with a 1 in 3. These frequencies, of course, apply only to London, but are probably very similar in other parts of the country which have the same total yearly rainfall.

Mr. Joseph Baxendell, who has examined—like so many other well-known meteorologists—the matter of periodicities closely, considers that the most probable values of short-term cycles in this country are 5.1, 3.09, 2.8, 2.4, 2.19 and 1.65, but adds that at least two of these *may* be close doubles. What has also to be considered is the occurrence of discontinuities, occasioned by the effects on regular oscillations of temporary external disturbing causes. "By phase-angle changes so produced," says Mr. Baxendell, "any of our mean amplitudes may be much reduced and the real importance of a periodicity accordingly masked proportionately." This may be the case with the 3.09 and 2.19 terms. He maintains that the 2.4 cycle is a marked and permanent one, and quite distinct from the 2.55-year half harmonic of the 5.1 cycle. Similarly, the 2.8 term is probably the second harmonic component of the 5.6-year cycle of European rainfall.

The cycles that Mr. Baxendell enumerates do not necessarily apply all to the same part of the British Isles, insomuch as all possible meteorological cycles are extremely local—one might almost say "parochial."

The trouble with so many of these cycles is that they are really mainly temporary, having appeared suddenly and after a while disappeared equally swiftly. Others have undergone an abrupt change, and altered their character completely, while others have gradually increased in intensity in a most promising way, and then faded into nothingness. Both meteorologists and industrialists will welcome the discovery of any new cycle that may add materially to British weather forecasting.

The Le Play Society.

The Le Play Society's programme for the Easter vacation offers varied and interesting scope for those wishing to extend their knowledge of peoples and their environment. Figuring on the programme are Morocco, including the Middle and High Atlas Mountains, with Mr. W. Fogg, the anthropologist (also a botanical group): a run from the north to the south of Portugal, including Lisbon, with Dr. L. Dudley Stamp, an opportunity for the geographer: Holland and its galleries, with Dr. G. Furlong: Glendalough, Co. Wicklow, a regional study with Dr. D. K. Smee: and the Cotswolds, a training course in Field Studies.

All these are open to lectures, teachers, students, and others who are interested in the studies undertaken. Information about these and summer courses can be had from Miss Margaret Tatton, Director, The Le Play Society, 58 Gordon Square, London, W.C.1.

In *Tables for Qualitative Analysis*, by F. Sherwood Taylor (Heinemann. 1s. 3d.), practical directions for the qualitative analysis of mixtures containing the common metals and acid radicles are set out in concise form on a series of fourteen cards, varnished to allow them to be used on the laboratory bench. The cards necessarily omit the theoretical explanation of the processes they describe. They are intended to be supplemented by reference to the teacher's notes, or to a text-book.

The Background of Modern Science.

By Charles H. Butcher.

For the first time we have been presented with a view of the whole field of natural knowledge in the 16th and 17th centuries. Professor Wolf, of the Department of the History and Methods of Science at the University of London, is a master of the art of lucid exposition, which he has found of great service in writing his recent history of the birth and growth of the modern scientific mind.*

THE early development of modern science was greatly influenced by the philosophy of the environment in which it grew. It emerged rather rapidly out of the Renaissance, when certain ancient tendencies began to appeal to those who were dissatisfied with the general mediæval outlook. In those days the natural phenomena had no particular interest for those who lived strictly to the vows of a religious life, but in due course the poets and painters began to find inspiration in such phenomena and set out to seek new facts with the aid of the literature of Greece and Rome. This new interest, however, did not necessarily exclude a religious attitude towards the world; Kepler's great astronomical discoveries were prompted mainly by religious aims, and in seeking the ways of God it may be said that he found the courses of the planets.

During the Middle Ages secular thought had to be subordinated to Church creeds or dogmas. At first the Church was contemptuous of all who sought knowledge of natural phenomena by intelligent reasoning; then it became hostile towards them, but did not hesitate to make use of scientific and philosophic argument in self-defence against the unbelievers and heretics. Thus it was that independent spirits such as Roger Bacon (1214-92) and Leonardo da Vinci (1452-1519) were effectively prevented from bringing about a revival of science in their own particular day.

The general arrangement of the solar system as conceived by Copernicus took the better part of a century to become firmly established in scientific thought. It was opposed from the beginning by Luther and his reformers; the Catholics only allowed it as a mathematical speculation, and Galileo was forbidden to teach Copernican astronomy, although he confirmed it as physical reality by astronomical observations. The work of Galileo in founding dynamics, or the science of moving bodies, was less spectacular than his astronomical discoveries, but from a purely scientific point of view it was of much greater importance. His investigation into the laws of falling bodies, the movement of pendulums, and of projectiles, were epoch-making.

In a subsequent chapter on the scientific academies of the 17th century, it is pointed out that the spirit of Galileo Galilei continued to march on after the Church of Rome had arrested his body, and so many were infected with his enthusiasm for experimental science that influential institutions were soon founded for the purpose of advancing experimental science by co-operative work. Of these new institutions the most notable were the Accademia del Cimento in Florence (1657), the Royal Society of London (1662), and the Académie des Sciences in Paris (1666).

From Copernicus to Newton.

The whole history of science, states Professor Wolf, affords few parallels to the development of astronomy from Copernicus to Newton. Beginning with the revolutionary conception of the earth as one of the smaller planets of the solar system (due to Copernicus), the work of Galileo, Tycho Brahe, and Kepler led progressively to Newton's great synthesis of the physical world. Newton, born in 1642, did not make his work fully felt until the 18th century. Its scientific effects, however, were immediate, and for more than 200 years Newton's *Principia* formed the basis of all astronomical and cosmological thought, for it was certainly an outstanding achievement to show in detail how the same principle of gravitation and the same laws of motion apply to the smallest particles of terrestrial matter as well as to the largest of the celestial bodies, and also to such a seemingly irregular happening as the tidal movement of water.

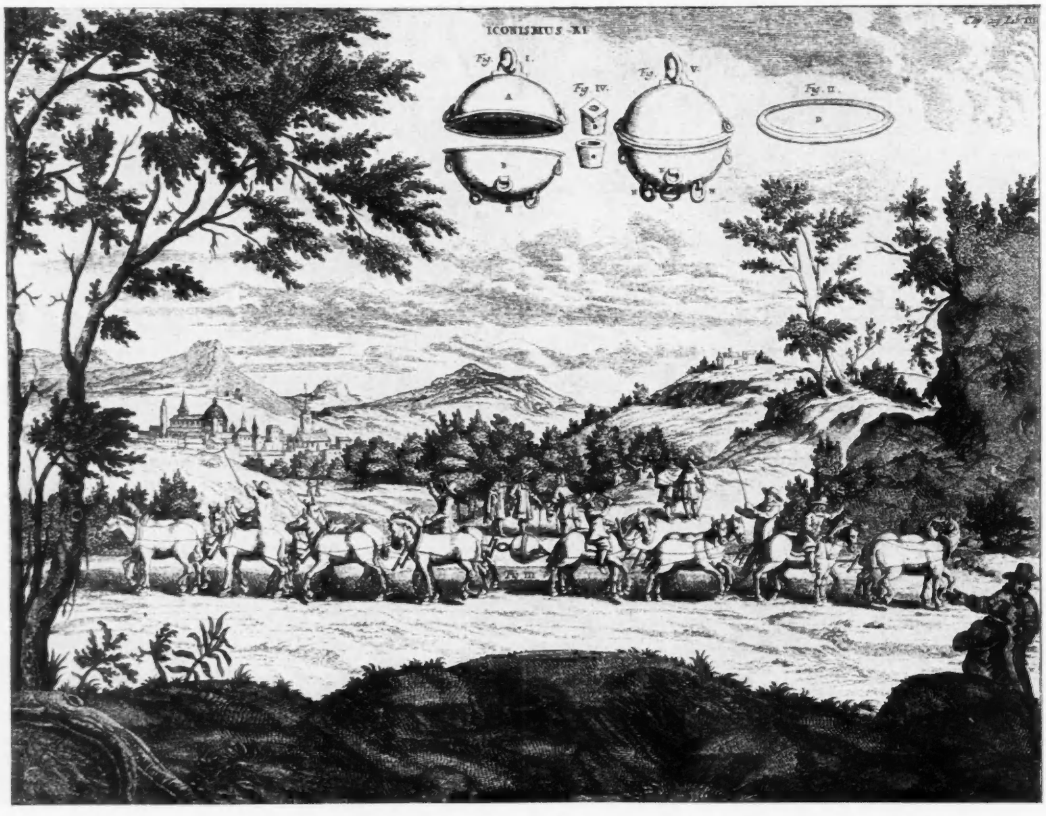
The modern history of the science of optics, we are told, may be taken as beginning with the fundamental researches of Kepler, whose principal contributions (published 1604 and 1611) dealt with refraction, the properties of lenses, and the theory of vision; it was Kepler also who gave us a geometrical explanation of the telescope. Subsequently Snell (1621) formulated the exact laws of refraction; Grimaldi (in a posthumous work two years after his death in 1633) suggested that light is wave-like or periodic in nature; and Huygens

* *A History of Science, Technology, and Philosophy in the 16th and 17th Centuries.* By Professor A. WOLF; with the co-operation of Dr. F. DANNEMAN and A. ARMITAGE (Allen and Unwin: History of Science Library. 25*s*.).

(1678) conceived the minute particles of a luminous body as communicating impulses to the neighbouring particles of an all-pervading medium. Then came Newton, who, " having darkened my chamber and made a small hole in my window-shuts, to let in a convenient quantity of the sun's light," placed a prism in the path of the ray and studied the colours of the spectrum. For opinion as to the nature of heat, science had to await the coming of Joule in the 19th century ; in the 17th century there was little or no clear distinction between heat, fire, and flame. Sound, on the other hand, received the attention of Galileo, who showed the dependence of the pitch of a note upon the rate of vibration, whilst the velocity of sound was measured by Gassendi, and Guericke showed that sound will not travel through space previously exhausted by the air-pump.

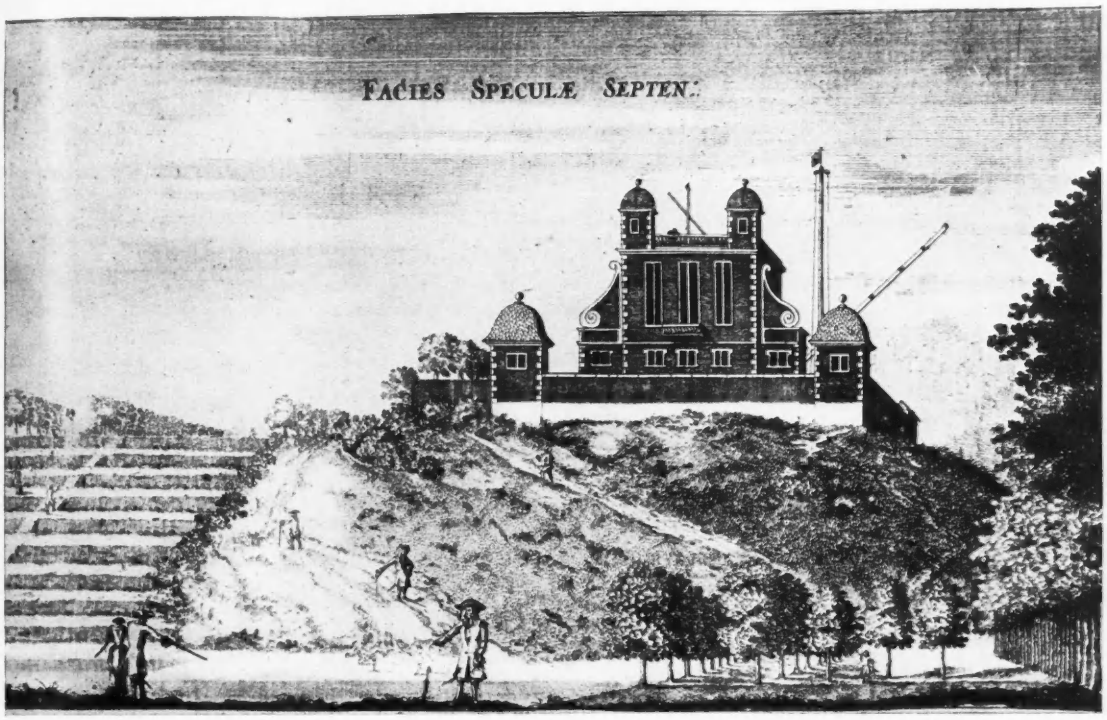
The experimental science of magnetism and electricity was founded by William Gilbert, of Colchester, who practised in London as a doctor and ultimately became physician to Queen Elizabeth, his *De Magnete* being published in 1600. As Professor Wolf points out, it was entirely due to Gilbert that the knowledge of electrical phenomena progressed beyond the few facts described by classical writers. Hitherto it was known that amber, when rubbed, acquired the property of attracting light bodies, but it fell to Gilbert to show that this property of amber is shared by numerous other substances and thus to establish the science of frictional electricity. New methods for studying natural phenomena, and the invention of the thermometer, barometer, and other meteorological instruments, simultaneously opened the way towards an exact study of the atmosphere in place of the astrological predictions or mere weather lore dating from the Middle Ages ; Dampier, the buccaneer, made observations on winds and ocean currents, whilst Halley and Hooke speculated as to their causes.

At Chapter XV Professor Wolf brings us to the science of chemistry, and points out that at the beginning of the period under review chemical investigation followed three main tendencies. First, there was the alchemists' search for the philosopher's stone by which



Guericke's experiment with the ' Magdeburg Hemispheres ' evacuated by air-pump (Ratisbon, 1654).

From Wolf's " History of Science," by courtesy of Messrs. Allen & Unwin Ltd



Greenwich Observatory in the time of Flamsteed, first Astronomer Royal (1675).

Reproduced by permission of the Astronomer Royal.] [*From Wolf's "History of Science," by courtesy of Messrs. Allen & Unwin, Ltd.*

it would be possible to turn base metals into gold. Secondly, there was a tendency to turn chemical knowledge to medicinal uses, not altogether dissociated from the alchemists' elixir which would prolong life indefinitely and serve as a cure for all its ills. The third tendency was associated with mining, or the need of chemistry in the extraction of metals from stones. Until Robert Boyle published his *Sceptical Chymist* in 1661, chemical theory was a mass of confused notions. It was Boyle who attacked the current assumption that all things were composed of three or four elements. He next attacked the contemporary misconception of the action of fire on chemical experiments, and his interest in the nature and action of fire nearly led him to the discovery of oxygen, for he observed that various burning bodies, when placed in the receiver of his air-pump, were extinguished when the receiver was exhausted.

Geology and geography provide interesting matter for the general reader, but there is a greater wealth of information in Chapter XVIII, which is devoted to the biological sciences (botany, zoology, anatomy and physiology, and microscopic biology). Here we are introduced to William Harvey (1578-1657) who professed "to learn and to teach anatomy, not from books, but from dissections," giving us his discovery of the circulation of the blood.

Among the remaining chapters of this book four are devoted to technology, and here Professor Wolf discusses the most outstanding developments in agriculture, textiles, building, mining, mechanical engineering, and the steam engine. His account of mining and metallurgy is especially interesting, for he draws largely upon that great work of Agricola, *De Re Metallica* (1556), for the illustrations; incidentally, the subject of mechanical engineering is also ably illustrated from the same source, the machines described by Agricola (various windlasses and hoists, dippers, suction-pumps, force-pumps, and ventilating fans) being intimately associated with mining operations and for the most part worked by men or animals.

Professor Wolf's book is greatly to be commended to all who wish to delve into the work and the lives of those who developed science and technology (and philosophy) in the 16th and 17th centuries. It is well illustrated by portraits and pictures from contemporary prints, and the result of his long and laborious task is sufficiently full and well documented to satisfy a long-felt want on the part of the serious student.

Gardens Within a Garden

By C. Stuart Gager

Director of the Brooklyn Botanic Garden

For systematic arrangement and efficiency in action the Brooklyn Botanic Garden holds a very high place. It is not forgotten, as the Director points out, that interest is the essential key to education; and here beauty and interest walk hand in hand with systematic science. Botanists and horticulturists will find much suggestive material in the straightforward account of the Garden's activities that follows.

THE title of this article has been used to describe the plantations of the Brooklyn Botanic Garden. It is a very happy phrase, concise and accurate, for the plantations comprise some ten or a dozen "gardens," and, in addition, numerous horticultural collections and miscellaneous plantings. There are different types of botanic gardens, varying from small areas planted according to some botanical principle as a part of a public park or college campus, to independent institutions like the Brooklyn Botanic Garden. The older botanic gardens chiefly served the purpose of growing plants collected for systematic study, and this suggests the distinction between the botanical and the horticultural point of view. For the botanist the garden exists for the plants; for the horticulturist the plants exist for the garden—the garden itself is the unit, and plants are of interest chiefly as materials out of which to make a beautiful garden.

The Japanese Garden, laid out in the traditional style with shrines and miniature bridges, designed and maintained by native Japanese.

A public Botanic Garden must combine both of these ideas. It must not only have a rich and well labelled collection of plants, classified so as to serve educational and scientific needs, but they must be so arranged as to make a beautiful garden. Such an aim is not only its own justification; it is essential for the largest educational results. People must be interested in order to be educated, and nothing is more effective than beauty to enlist the interest of the average person.

But a Botanic Garden involves much more than a garden. It is a scientific and educational institution, with a programme of botanical investigation and public instruction. The aim of the Brooklyn Botanic Garden has been stated as "anything scientific or educational based upon plant life." The programme includes various aspects of botanical research and public education extending from children's gardening and nature study to adult education and post-graduate research.

Instruction is given largely in classes, supplemented by public lectures, laboratory and field work, radio broadcasting, popular and technical publications, and by maintaining a bureau of free public information on all aspects of plant life and gardening. Of course, the distinctive and most important educational tool is the labelled plantations. One can seldom walk through the grounds of the Brooklyn Garden without seeing classes from schools or one or more persons studying plants and copying labels or taking other notes.

The library of the Garden, comprising about 20,000 books and 16,000 bound pamphlets, is open free daily to the public. Current issues are on file of 1,000 periodicals dealing with all aspects of plant life. There is a

The Children's Garden: a busy scene on Saturday mornings.

rich collection of botanical incunabula, old herbals, and other pre-Linnæan items, and these books are among the more frequently consulted. The library staff renders bibliographic service by post and telephone as well as to those who call in person. The library is administered as a reference library. Books are not lent to individuals, but by generous co-operation in a system of inter-library loans any publication (except the rare items) becomes readily available to readers in all parts of the city and in other cities. In connection with lectures and "flower days" publications relating to the topic to be considered are placed on the open shelves and tables. Bibliographies are published from time to time.

The "flower days" are days set apart for the consideration of some one flower (rose, iris, daffodil, etc.) at a time when the given flower is at its height of bloom. Members and their friends are invited to a lecture and round-table discussion, and the given flowers are also visited on the plantations. Sometimes the talk and discussion take place outdoors where the flowers are growing—in the Rose Garden, the Japanese Garden, on Cherry Walk, etc., as the case may be.

Commercial and trade services include information to nurserymen, florists, and others. For example, advertising agencies are supplied with source material for advertisements of plant products, publishers with photographs for illustrating botanical and geographical publications, and manufacturers with sources of design for textiles and wall paper, and information concerning sources of fibres.

The herbarium, of about 150,000 sheets, is specially rich in the local flora, and is freely open to the public for consultation. It is not the aim of the Garden to develop a large general herbarium.

In research special emphasis is placed on pathology, genetics and plant breeding, ecology, local flora, and on general systematic botany. By co-operative arrangements work done at the Botanic Garden is accepted by three local universities for credit towards advanced degrees.

The Brooklyn Botanic Garden makes a special point of co-operating with public and private schools of all grades. Study material (living and preserved plants and plant parts, petri dishes with sterilised agar, etc.) is supplied annually to about 5,000 teachers in some 200 schools, for the instruction of about 240,000 pupils. Each year hundreds of potted plants are placed in classrooms of local schools merely as objects of beauty. An extensive and valuable service is the supplying of penny packets of seeds to school children for planting in school and home gardens. About one million packets were supplied in 1935. Teachers bring large numbers of classes to the Garden to visit the plantations and

conservatories under guidance, for motion-picture and other lectures, and for practical work in three instructional greenhouses. The annual attendance in school classes is about 50,000 a year. In addition the Garden has classes organised independently of the schools, also with an annual attendance of about 50,000. In numerous cases young people continue voluntary attendance at Garden classes for from four to seven years, and often study some aspect of botany or horticulture in the university or for a career.

The plantations comprise the following sections and gardens :

1. General Systematic Section, with plants arranged by orders and families. There is no separate arboretum, fruticetum, and herbaceous garden, but the trees and shrubs are grouped with the herbaceous plants to which they are botanically related. This is, perhaps, a unique plan for a botanic garden.

2. Local Flora Section, comprising only plants that grow wild within approximately 100 miles of Brooklyn.

3. Japanese Garden, of the *Niwa* or landscape garden type, covering about two acres of land and water, with four cascades, a tea house, Shinto shrine devoted to Inari, the Protector of Harvest, and a Torii standing in water like the famous one at Miyajima, on which it is modelled.

4. Rock Garden. Probably the first in a public park in America, except the one in Golden Gate Park, San Francisco.

5. Rose Garden, comprising about 3,000 shrubs, climbers, post-roses, standards, and festoons. The border planting comprises a rich collection of species roses. The horticultural varieties are grouped in beds of Hybrid Teas and Hybrid Perpetuals, arranged in chronological sequence so that one passes from the "old-fashioned" roses at the north end, past newer and newer varieties, to the most recent introductions at the south end.

6. Medicinal Plant Garden, comprising also a section of culinary herbs and another of plants poisonous to taste and smell.

7. Children's Garden, with individual plots where about 200 children, after taking certain preparatory courses in gardening, may grow vegetables and flowering plants under close supervision. There is a Shakespeare Garden at one end of the Children's Garden.

8. Wall Garden, 385 feet long, first planted in 1935.

There are also water gardens, an iris garden with special emphasis on Japanese Iris, various horticultural collections (lilacs, peonies, cannas, flowering trees, etc.), and naturalistic plantings of bulbs in the lawns. There is an experimental garden and, as usual, a nursery. In years of mild winters there are twelve months of outdoor bloom.

In the Local Flora Section : the Glacial Pool and Sand Area, with Oxeye (Heliopsis helianthoides) *conspicuous on the right.*

National Trust News.

LAST spring it was decided that the time had come when the Trust should have an emblem or symbol to be used on its properties as a sign of Trust ownership. There are something like three hundred properties in England and Wales on almost all of which it is necessary to have notice-boards, commemorative tablets, signposts, or boundary marks, and it seemed desirable that some standard form should be designed that would be easily recognisable by the general public and yet would not offend when placed on mountain-sides, in woods, in meadows, or on ancient buildings.

A competition was arranged inviting designs for an emblem that could be adapted for various purposes in connection with the properties and could also, perhaps, be used on notepaper or on the cover of the Annual Report. One hundred and nine entries were sent in, but none of them was considered suitable by the committee of judges, who then decided to ask six men, prominent in art and design, to submit drawings incorporating either the English lion, the oak, or the rose. The judges chose, out of this restricted competition, the drawing submitted by Mr. Joseph Armitage; it consists of an omega-shaped frame, with the words, "The National Trust" round the semicircle, a sprig of oak leaves in the centre, and space for the name of a property at the bottom.

The "omega" form was deliberately selected by Mr. Armitage so that the outline of a National Trust notice should at once be recognised from a distance; it has the advantage also of being different from the many other signs on the roads and in the countryside. Oak leaves were decided upon rather than a lion or rose as being a less common heraldic symbol of England; they are more easily reproduced and are less likely to be altered in the course of time and many copyings. It will be remembered that Mr. Armitage was responsible for re-designing the famous "King's Beasts" on St. George's Chapel, Windsor.

A brief notice will, in suitable cases, be placed below the emblem on the same post, and the by-laws will be printed on paper in small type and pasted on the back. By this means it will be possible to do away with the existing by-laws boards which, being so large, are sometimes a disfigurement. If they are to be enforced it is legally necessary for the by-laws to be shown, and the Committee hopes that the new notice will be both smaller and more seemly.

Longshaw Moor.

Longshaw Moor was bought as the result of a long-drawn-out effort in 1927-32 and its 747 acres have been greatly appreciated by the general public and especially by those who have stayed at Longshaw Lodge (which is let as a Guest House). The estate is particularly valuable owing to its nearness to Sheffield; many visitors go there every week-end, and the place is patrolled by wardens, who were the first "Countryside Wardens" anywhere in England. The moors to the north and east of Longshaw, all originally part of the Duke of Rutland's property, have been bought by local authorities and are therefore more or less preserved, and freer access to them has recently been granted.

The emblem of the National Trust.

To the west the National Trust estate ends, for the present, at the Surprise Rocks, where there is a turn in the road as you go from the Fox House Inn towards Hathersage, and suddenly the Derwent Valley is spread out before you and there is a wonderful distant view looking towards the Peak. The foreground to this view was recently discovered to be in imminent danger of being spoilt by building, and so the National Trust Longshaw Committee felt that, in the absence of control by planning, the area should be bought for the Trust and so preserved in its rural state for ever. Hence the appeal for £7,000, which is the sum required for the purchase and legal expenses, leaving a small balance for maintenance during the first few years. The lower portion will be reserved for agricultural and woodland purposes, and the upper portion will be available for enjoyment by the public.

New Acquisitions.

New properties recently accepted by the Executive Committee include the Beacon at Braunton, near Barnstaple, a view-point overlooking Braunton Burrows (a famous place amongst naturalists) and Braunton Great Field, and an additional three acres at the Moat House, Earlswood, given by the Misses Smythe in order to protect the amenities of the property, which they handed over to the Trust in 1929. Another addition is a cottage in Church Row, West Wycombe. This was purchased in accordance with the general policy of the Finance Committee who are trying gradually to increase their investments in property in that village.

Rail Transport Development, 1935.

By Major A. P. Le M. Sinkinson.

PROBABLY more progress was made on the railways in 1935 than in any previous year, at any rate since the early days of mechanical transport. In every direction there has been development ; in some directions it has been startling. But such is the tendency of the travelling public to take improvements for granted that it may be worth while to refer to them, however briefly.

Passenger services have seen remarkable acceleration. According to the *Railway Magazine* for January, 1936, the total mileage in Great Britain at 60 m.p.h. and over, start-to-stop, has leapt from 2,607 in October, 1934, to 5,371 in October, 1935—in other words, it has more than doubled. A large part of this improvement is due to the enterprise of the L.M.S., which has increased its 60 m.p.h. mileage from 951 to 2,361—at the moment the highest of any British railway. The fastest L.M.S. schedule is now that provided by an up Birmingham express, which runs from Rugby to Watford, 65.1 miles in the even hour.

The G.W.R. and the L.N.E.R. have been even more enterprising in introducing some ultra-high-speed expresses. The G.W.R. *Bristolian* averages 67.6 m.p.h. between Paddington and Bristol viâ Bath, and 67.2 in the reverse direction viâ Badminton. The L.N.E.R. *Silver Jubilee*, running between London and Newcastle, is a specially built streamlined express, normally hauled by a streamlined Pacific. It averages no less than 70.4 m.p.h. in either direction between King's Cross and Darlington, a distance of 232.3 miles—the fastest run of over 200 miles in the world. Though this run is not as fast as the G.W.R. " star turn " on the *Cheltenham Flyer*—71.4 m.p.h. over the 77.3 miles from Swindon to Paddington—it is more than three times as long. All these British high-speed runs are operated by steam.

But these figures have now been beaten in America. The acceleration of passenger trains in the U.S.A. during the past few years reached its climax in 1935. At the end of 1930, the *Railway Magazine* for February, 1936, informs us, the total mileage of 60 m.p.h. runs on the North American continent was only 1,106 ; to-day it is 19,279. This impressive mileage is nearly four times that of Great Britain ; but when it is remembered that the total route mileage in the U.S.A. is about twelve times that in this country, the figure loses some of its sting. The 19,279 miles are divided between steam (9,469 miles), electricity (7,471 miles), and diesel propulsion (2,339 miles).

The world's fastest steam-hauled start-to-stop runs are now performed in the U.S.A. The *Union*, a crack express of the Pennsylvania RR., has five short runs booked at over 70 m.p.h. ; the *Detroit Arrow* has three. The fastest run of all is that of the *Union*, between Valparaiso and Plymouth—40.3 miles in 32 minutes, at 75.6 m.p.h., start-to-stop. The *Hiawatha*, belonging to the Chicago, Milwaukee, St. Paul & Pacific RR., has four runs booked at over 70 m.p.h. Of the electric services, the Chicago, North Shore & Milwaukee RR. has a short run of 15 miles in 12 minutes, at 75 m.p.h. The fastest Pennsylvania electric service is that provided by the *Congressional*, between Newark and North Philadelphia—75.9 miles in 66 minutes, at 69 m.p.h. The *Zephyr*, of the Chicago, Burlington & Quincy RR., is a diesel-operated train with a highest start-to-stop speed of 74.5 m.p.h. between two stations 54.6 miles apart.

The Highest Railway Speeds.

On the continent of Europe steam cannot show such speeds. So far as can be ascertained, the highest booked speed in Europe (outside England) is that provided by the *Sud Express*, which is due to cover the 70 miles between Poitiers and Angoulême in 60 minutes, at exactly 70 m.p.h. But when we turn to the diesel-railcars of Germany, we find the highest speeds in the world. In 1935, for the first time in railway history, start-to-stop bookings of 80 m.p.h. and over made their appearance. One railcar runs from Berlin (Zoo) to Hanover, 157.8 miles, in 115 minutes, at 82.3 m.p.h. Another runs from Leipzig to Berlin (Anhalt), 102.2 miles, in 76 minutes, at 80.8 m.p.h. The famous *Flying Hamburger*, with its 77.4 m.p.h. booking between Berlin and Hamburg, is put in the shade by these and by several other extremely fast German bookings.

France has numerous speedy railcars. A Bugatti car runs twice daily between Paris (St. Lazare) and Havre, 141.5 miles in two hours, at 70.8 m.p.h., including a stop at Rouen—this over the State Railway, which was once a byword for leisurely travel. The fastest booking is that between Havre and Rouen, 54.9 miles in 45 minutes, at 73.2 m.p.h.

Fast diesel services now operate in other Continental countries, some of which never used to figure in speed tables. Denmark, for example, has a series of *Lyntog* (" Lightning Trains "), one of which has a booking of 60.4 m.p.h., start-to-stop. Poland boasts a railcar scheduled to run between two stations 53.4 miles apart in 46 minutes, at 69.6 m.p.h. This run is on the fast railcar service between Warsaw and Katowice.

The improvement has not been confined to passenger services. In Great Britain freight expresses have been multiplied, until there are now several performing long non-stop runs at quite respectable speeds. In Germany, fast goods services are provided by the *Leig* railcars,

which are diesel-driven parcels vans hauling one or two goods wagons.

The improvement in passenger and goods services has been made possible by notable developments in the power provided. For steam propulsion, the most outstanding results have been seen in France, with rebuilt Pacific locomotives, as detailed in DISCOVERY in January, 1936. Besides these reconstructions, a Pacific with smaller driving wheels, similarly rebuilt but converted into a 4-8-0, has performed some amazing work with very heavy loads.

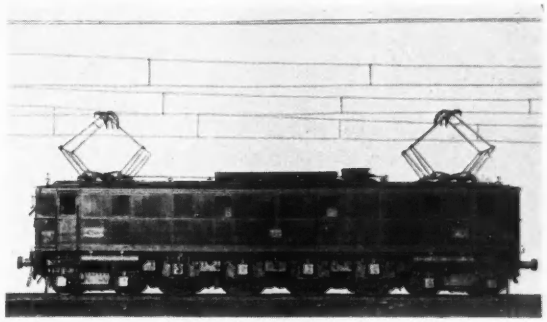
In Great Britain, *Silver Link*, the first streamlined Pacific of the L.N.E.R., beat four world's records on the trial run of the *Silver Jubilee* on September 27th, 1935. This 4-6-2 generally resembles the Super-Pacifics of the L.N.E.R., but it has a higher working pressure and smaller cylinders. The type has recently been multiplied. On the record-breaking run *Silver Link* covered 25 miles at an average of 107.5 m.p.h., and over 41 miles at 100.6. The maximum speed—twice attained—was 112½ m.p.h. This maximum does not quite equal that recorded by a specially built streamlined German 4-6-4, which is credited with a momentary speed of 119 m.p.h. when hauling a light experimental train in 1935. Otherwise *Silver Link* appears to have swept the board.

On June 27th, 1935, the L.M.S. Pacific No. 6200, *The Princess Royal*, hauling the heavy load of 475 tons on the 6.12 p.m. from Crewe to Willesden Junction (5.25 p.m. from Liverpool to Euston), covered the 152.7 miles in 129 minutes 33 seconds. This works out at the high average of 70.7 m.p.h. start-to-stop, although the three service slacks were carefully observed and the maximum speed did not exceed 86½ m.p.h. The gain on schedule was 12 minutes 27 seconds. Later, the L.M.S. turbine-driven *Pacific*, No. 6202, hauling the normal load of 345 tons, gained 11 minutes on this high-speed schedule, reaching a maximum of 90.

As for diesel propulsion, locomotives, railcars and complete trains have multiplied in many countries of the world; but, except on the G.W.R., there is little to report in Great Britain.

Electric Traction Advances.

Electrification has developed on the Continent. Ambitious schemes are being carried out in France, Italy, Sweden, Austria, and other European countries, to say nothing of activities further afield. In France the greatest progress is reported on the Paris-Orléans-Midi Railway. By 1937 it is hoped that the whole of the main line from Paris to Irun, on the Spanish frontier —the route of the *Sud Express*—will have been converted to electric traction. The distance is 512 miles. The other main line of the Paris-Orléans-Midi, now



Electric express locomotive, P-O-M railways.

electrified for half its length, will shortly be converted as far as Port Bou, 605 miles from Paris. The State Railway has also a main-line electrification scheme in hand between Paris and Le Mans, a distance of 131 miles. In Belgium the 27.7 miles between Brussels and Antwerp have been electrified. The extensive schemes in England, on the Southern, the L.M.S., and the L.N.E.R., are fresh in the mind.

Correspondence

SURVIVAL OF FAUNA IN THE ICE AGE.

To the Editor of DISCOVERY.

Sir,—When writing the article on the Origin of our British Orthoptera, which you were good enough to publish in your November number, I did not know a very important work, *Die Insektenfauna Islands und ihre Probleme*, by Carl H. Lindroth (Uppsala, 1931), which I had overlooked because there are no indigenous Orthoptera in Iceland. But it has an important bearing on the subject, as Dr. Lindroth, after elaborate discussion, arrives at the conclusion that there are two sheltered spots in the island where the existing fauna and flora were able to survive even the Worms glaciation. Not only is there a fairly luxuriant flora, with substantial trees, but a rich fauna, including flightless insects. This is a difficult nut for those who maintain that almost the entire fauna and flora of Britain were destroyed by the glaciation, for there can be no question of post-glacial colonisation of Iceland by other than synanthropic insects. But the author adds a still harder one, that this rich oasis is situated not more than 1,200 to 1,400 metres, less than a mile, from the edge of a perpetual icefield.

As yet further evidence of the persistence of life near ice, he quotes Böving (*A Summer Trip to Iceland*, Proc. Ent. Soc., Washington, xxvii, 1932), who found a "dense and various vegetation" with several species of insects, growing on a layer of detritus and soil only 4 mm. thick, actually on top of the ice itself. He adds, "It is really astonishing how little the plants and insects were affected by having the ice underground."

These two relict spots are not kept warm by geysers or hot springs, but merely sheltered by the contour of the high ground. The facts are undoubted, and the interpretation can hardly be questioned. If such a thing can happen in Iceland, how much

easier was it for relict fauna and flora to survive in Britain, especially in the mild south-west, and, above all, in the south-west of Ireland, with full enjoyment of the Gulf Stream.

Yours faithfully,

MALCOLM BURR.

The Hermitage, Dorney, Windsor.

ANCIENT SWEAT-HOUSES.

To the Editor of DISCOVERY.

Sir,—In your February issue you have an article entitled, *Prehistory in Portugal*, in which an Irish archæologist suggests the "sweat-house" idea for those underground buildings (see p. 56).

If they were used as such might not the "polished stones" found in them have been used for massage?

The Japanese use polished *wood* balls of different sizes for this purpose.

Yours faithfully,

(Mrs.) M. G. STUART.

Mount Stuart, Bankfoot, Perthshire.

PITCAIRN ISLAND TO-DAY.

To the Editor of DISCOVERY.

Sir,—I should like to supplement the article on Pitcairn Island (in your January issue) by a few words as to the great improvement wrought in the island since the arrival of the Seventh-Day Adventists in 1886.

Captain Doughty, who called at the island in the *Constance* in 1884, sent home a very depressing report of the state of affairs, saying that the people had lost much of their old vitality, that "their houses were not so clean nor the gardens so well kept—even the grave of John Adams being overgrown with bushes."

What the colony most needed was a revival. And, just in time, it came. "The first stirrings of a new life," writes W. Y. Fullerton, in his book *The Romance of Pitcairn Island*, "seemed to come from the visit of John I. Tay, a Seventh-Day Adventist, who arrived in October, 1886." Within two weeks of his arrival, a parcel of tracts sent ten years before by the Seventh-Day Adventists, but regarded with suspicion at the time, bore fruit. The whole community decided unanimously to commence the observance of the Sabbath on the seventh day of the week (Saturday).

The islanders had been brought up from childhood to regard the Bible as the Word of God, thanks to the Bible and Prayer Book which had been brought ashore by Christian and which had led to the conversion of John Adams, the leader of the community. They were, therefore, ready to accept the simple scriptural teachings of the Seventh-Day Adventist missionary, and shortly after his departure, they decided to discontinue the use of the Book of Common Prayer.

Four years later, John I. Tay returned with Mrs. Tay and other missionaries on the Seventh-Day Adventist schooner *Pitcairn*, whereupon the entire adult population was baptized by immersion and a church and Sabbath school organised, amid scenes of much rejoicing.

Since that day in 1890 the Pitcairn islanders have remained faithful and enthusiastic members of the Seventh-Day Adventist church, contributing to the best of their ability to its funds for sending the gospel to less favoured lands. Every member gives a tithe of his income to the Lord, every tenth orange tree, bread-fruit tree, and coconut tree being branded with the sign LX—the Lord's tenth. Every tenth row of produce, whatever it may be, is marked in the same way as devoted to God, while every tenth watermelon has the sign scratched upon its skin.

No intoxicating liquor of any kind is ever used on the island, nor does anyone ever smoke tobacco. Religion on Pitcairn to-day is real and practical, entering into every phase of life. And if this island is indeed, as many testify, the happiest spot on this troubled earth to-day, it is because the Bible is exalted in the homes of its people and the love of Christ is cherished in their hearts.

Yours faithfully,

A. S. MAXWELL,

Editor of *The Present Truth*.

Stanborough Park, Watford, Herts.

The March of Knowledge.

American Palæoliths?

Stone implements of palæolithic type, rejects, fragments, and pebbles, numbering in all nearly eleven hundred, have been discovered in the river terraces along the valley of Black's Fork, Wyoming, by members of the University of Denver Archæological Survey. Professor E. B. Renaud, reporting on the discovery at the recent meeting of the American Association for the Advancement of Science, stated that he had classified the implements into five groups according to their typology, and that in form they follow the European cultural sequence of Chellean, Acheulean, etc. This is the first recorded discovery of such a complex of stone implements in America, and its importance is regarded as considerable; but a report on the geology and stratigraphy of the site is awaited before it will be possible to pronounce upon its bearing on the chronological problem of the antiquity of man in America.

Deuterium Compounds

It is only two years since Professor Urey isolated the heavier isotope of hydrogen in the form of its oxide, heavy water. The preparation of this deuterium oxide is a long and expensive process, and is only possible on a commercial scale where exceptional resources of power and raw materials co-exist, as they do at Billingham. Imperial Chemical Industries, Ltd., now offer for sale not only D_2O, but also sulphuric acid, nitric acid, caustic soda, hydrochloric acid, etc., of the total hydrogen atoms in all of which at least 95 per cent. are deuterium. Deuterium compounds have already found application as a new tool in the hands of the research worker concerned with the investigation of the movements of atoms during chemical change.

New Atomic Theory

Professor Niels Bohr, whose work on the theory of the atom is of prime importance, described a new theory relating to the nucleus of the atom at a lecture delivered recently in London. The essential part of the theory, which affords a fuller explanation of many of the phenomena of artificial radio-activity than has so far been attainable, is that the nucleus must be considered as a whole—a concentration of energy rather than a collection of particles.

(*Continued on page* 91.)

The Church at Umanak, with the distinctive silhouette of the Umanak Tind in the background.

The World's Northernmost Stone Church.

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The following account of an interesting ceremony in Greenland is adapted, by permission, from the "Polar Record," the journal of the Scott Polar Research Institute, Cambridge. We are indebted for the photographs to Miss Isobel Hutchison, whose untiring work on behalf of Greenland is well known.

The Provost of Jakobshavn, Greenland, who conducted the dedicatory service at the new church.

Towards the close of last summer season the little colony of Umanak, in the far north-west of Greenland, celebrated one of the most important events in its history, when its fine new stone church—the first of its kind to be built in Greenland, and probably the most northern stone church in the world—was dedicated.

The church, which has been in course of erection for the past four years, stands on the same site as the old wooden church which it replaces in the centre of the settlement, under the towering cleft peak of the Umanak Tind (a mountain which has given its name—"heart-shaped"—to the colony and the little rocky island on which it stands). Built of grey granite cut from the surrounding rocks, the church has been constructed by the natives themselves under the guidance of two expert Danish carpenters and masons, and is a handsome building of a kind not hitherto seen in Greenland, where all the other churches are of the wooden Scandinavian type. In the belfry hang two bells, one of them an interesting link of friendship between Britain and Greenland, being purchased out of fees for lectures on Greenland given in Scottish towns and villages by Miss Hutchison. It is inscribed with the name given by the Greenlanders to all Britishers, *i.e.*, "Tuluk" a name which is said to have its origin in the ships' biscuits—"tulussaq"—first introduced into Greenland by the Scottish whalers of last century.

The morning dedicatory service in Greenlandic, conducted by the Provost of Jakobshavn, was attended by the Governor-General of Greenland, the Governor (Landsfoged) of Northern Greenland, and a distinguished company. From every remote settlement around the natives had come into Umanak by motor-boat, schooner, or *umiak*, and the church's seating capacity was overtaxed. In the evening was celebrated the first wedding in the church, at which the bride was resplendent in her handsome national dress of scarlet boots, sealskin trousers, and *anoraq* with magnificent bead collar.

(*Continued from page* 90.)

So far, the statistical working out of the theory has led to answers more in consonance with experimental discoveries than has hitherto been the case and interesting developments are awaited.

Syrian Expedition

An expedition conducted by Sir Leonard Woolley, on behalf of the British Museum, is about to start excavations in northern Syria, in the neighbourhood of Antioch, the meeting-place of Asiatic civilisations. The object is to throw light on the origin of civilisation in Europe by tracing possible connections between the art of early Crete and that of the Asiatic mainland. The two sites chosen for excavation are, respectively, at the mouth of the Orontes and between Aleppo and Antioch, both points on the natural route of communication between Knossos and the Syro-Hittite towns of the interior, and evidence of a connection between Crete and Western Asia may well be forthcoming.

Earth Sculpture Laboratory

The *Geographical Journal* reports the construction, by Professor Ogilvie, of Edinburgh, of a laboratory to demonstrate how the form of the Earth is moulded by the combined action of rain and the waters of the rivers and the sea. Material to represent the earth is derived from a mixture of pot-clay with an early lake sediment found beneath the city, and the lay-out of the landscape can be altered as circumstances require. One of the great difficulties is to produce a spray sufficiently fine to reproduce the effect of rain on a greatly diminished scale.

Book Reviews.

Soviet Geography. By N. MIKHAYLOV, with a foreword by the RT. HON. SIR HALFORD MACKINDER. (Methuen. 10*s*. 6*d*.)

Exempt from the ethical checks that operate in normal life, from ordinary economic principles, from the necessity of making things pay, from political opposition, from the pressure of public opinion, with unfettered control over limitless resources both of men and money, with one-seventh of the earth's surface for a laboratory, the Bolsheviks have an opportunity unique in history for experimentation with minerals, plants, and animals, including man, on a scale unheard of. They are not missing it, and this book is a triumphant recital of their achievements.

Within its narrow frontiers, the British public cannot digest the astronomical figures of Russian statistics, and generally accepts them with a smile of incredulity. But Russia is a land where distances are recorded in hundreds of kilometres, journeys by the day of 24 hours (*sutki*), quantities by the hundred tons, and men by the million. In Siberia, where men are fewer, distances yet vaster are reckoned by the thousand kilometres, journeys by the week, quantities by the thousand poods (14 tons), and temperatures by decades of degrees on the Réaumur scale. I have myself experienced —45°R., that is about —72°F., in the sun at noon. In such a country anything is possible, and ordinary standards do not apply, either material or spiritual, and we must be prepared to accept tremendous figures and surprising statements. Still, it is not possible to read this very interesting book otherwise than *cum grano*. The author soars upon the pinions of ambition, and the dreams of the Bolsheviks are here surely often recorded as facts. But even with this proviso, so long as we realise that their swans are often geese, and sometimes even ducks, that their intensity of desire and effort is so powerful that it seems to them identical with achievement, this book is remarkable.

Surprising geographical discoveries are recorded. The author tells us that Obruchev, who has previously done good work on the Lena goldfields, has made wonderful discoveries of new mountain ranges in Yakutia. But his account of them is exaggerated and inaccurate, and the diagrammatic map on p. 21 is positively misleading; it should be compared with the one published in the November number of the *Geographical Journal*, illustrating a paper on this very subject by Obruchev himself. The author also implies that the whole credit for the exploration of this uninviting region is due to Soviet exploration, without any mention of Middendorf, the discoverer of the Stanovoi and Yablonovi ranges, of Kropotkin (1875), and several other travellers down to Bagratuni in 1913. Yet none of these were of the "soldier explorer" type, of whose work in Central Asia the author writes so patronisingly.

There is so much enthusiasm in the book that it is quite readable, in spite of the mistakes and repetitions, but does the author really think that not a single nationality in the U.S.S.R. is now dying out? Have they really saved the last few hundred Lamuts and Yukagirs, or are they already extinct? And does he honestly believe that to-day in Russia there is no "exploitation of man by man."?

The author is lyrical upon the emancipation of the non-Russian nationalities, who are now enjoying high-sounding autonomy. In the Crimean Republic I found that the chief result of autonomy was that they retained the best of their wine and sent the worst to Moscow. In the Buriat Republic I found that the Russians, who had already in Tsarist days dispossessed the Buriats from the best land, asserted their autonomy by permitting the unrestricted sale of vokda. In the enormous Republic of the Yakuts, where I spent nearly half a year, the President was a young Russian mechanic, and the poor Yakuts had little voice in affairs. But it is nice for these scores of peoples to have their languages reduced to writing, in the Latin alphabet, and to have real newspapers of their own, including, I am told, the Gypsies.

The book is in the vigorous, staccato style of modern Russia. Many passages suggest that it was written by a Russian who had studied English, and the publishers would have been well advised to have had the text revised by an Englishman with a knowledge of the subject, for there are numerous errors and plenty of incorrect phraseology. For instance, "thicket" (*pushcha*) for "forest," "pit-hole" for "well," or "drill-hole," and quite unnecessarily "natrium" for "soda," and Kara Kalpakian and Kara Kirghizian for Kara Kalpaks and Kara Kirghiz; there are no mouflon in Russia (unless artificially), nor are there panthers in Central Asia; by wild oxen is presumably meant bison, which the author, like many better men, miscalls aurochs, and makes us wonder what he can mean by an aurochs-bison cross. Such instances could be multiplied freely.

This book will certainly be useful, if only because it gives the undisputed facts accurately. When in a didactic work upon the Five Year Plan a lecturer in Economics in an English University confuses the Kara Kalpaks with the Kara Kirghiz and alludes to "Aral highlands," it is high time that we had available a book of reference by a man who knows his geography.

MALCOLM BURR.

Race, Sex and Environment. By J. R. DE LA H. MARETT. (Hutchinson. 21*s*.)

When the day comes for assessing the value of contributions to the study of race in 1935, Mr. Marett's book will assuredly take a high place. It is true that much of what he has to say is highly speculative, so far as present knowledge goes, and, to adapt his own words, he raises more questions than he answers; but he formulates a theory of the interaction of man and his environment, which opens up the prospect of a most fruitful field of research. It goes far to afford anthropological studies a basis in a theory of causation, which gives them a unifying scientific method of approach they have hitherto lacked.

Mr. Marett's line of argument is that the constitution of the soil determining the character of man's food is of fundamental importance in determining his physique, his mental qualities, and ultimately his social relations. The character of the soil depending on climate, food thus affords the link of causation in the relation between man and his geographical environment. The author's study of the effects of soil deficiency in relation to animal husbandry have led him to the view that present heredity, being determined by past habitat, "geographical and geological conditions have been the main agency in regulating the incidence of natural selection upon animal and human evolution." Hence in studying the mineral deficiencies of various types of soils and their relation to food values, he finds facts which appear to define the long-suspected bearing of the endocrines on evolution, to which Sir Arthur Keith has repeatedly directed attention. Mr. Marett devotes several chapters to a detailed examination

of how excess or defect in minerals may have been responsible for specific trends in human evolution, as, for example, in affecting the growth and distribution of hair or in causing the extinction of the big-boned races of man as climate changed in the later phases of the Pleistocene epoch.

It will be appreciated readily that Mr. Marett's theory is of far-reaching significance. It may well be that, should his views find confirmation in further research, they will provide a key to many of the puzzles of the geneticist.

Mr. Marett, however, does not stop here, nor remain content with his contribution to the study of human heredity in physical character. He turns to man's mental qualities and their most characteristic consequences as embodied in the forms and institutions of human society, ranging from marriage and the family group to the modern state. Nor does he hesitate to attack the most difficult of problems, such as the relative position of the sexes and the future economic and political development of the human race. Here, in dealing with material of almost infinite complexity, he is naturally more difficult to follow, while his theories enter more and more into the realms of speculation.

It must be admitted that, granting the author's major proposition as a working hypothesis and basis of investigation, his views of causation in the development of societies, in relation to forms or types of human constitution and character, have the merit that they open the way to a real unitary science of human biology, instead of a biology of man, standing apart from psychology and cultural anthropology, which is all that we have at present. How far they will stand the test of detailed critical examination, time and further research alone will show.

E. N. FALLAIZE.

The Story of the Bible. By SIR FREDERIC KENYON, K.C.B. (Murray. 3*s*. 6*d*.)

In this book Sir Frederic Kenyon has presented a happy gathering of facts for the general reader and the student of the "literature of religion." In the space of 144 pages he gives a full story of the writing and publishing of the Bible, and of the discoveries made in manuscripts which have come to light since the English Authorised Version of the Bible was first printed in 1611. Many of these discoveries have modified and extended our knowledge of the text, and the most recent of them promise to be of the highest importance. The real "age of discoveries" came after the publication of the Revised New Testament in 1881 and the Revised Version of the Old Testament in 1885. Foremost among these discoveries we may place the Chester Beatty Biblical Papyri, of which a full account was given by Sir Frederic Kenyon in DISCOVERY, November, 1933 and June, 1935. Such manuscript sources as these, aided by the actual possession of the Codex Alexandrinus (which came to England in the reign of Charles I) and the Codex Sinaiticus (historically described in DISCOVERY, February, 1934, immediately after being purchased by the British Museum) will do much to strengthen our proof of the authenticity of the Scriptures and give us a text which is true to the original as far as that is possible. There are possibly very few people who have never shown any desire to know how the text of the Bible was preserved and handed down to us prior to being translated into English and printed. Many of us have even asked whether the texts were accurate copies of the books as they were originally written by Old and New Testament authors. But not until the coming of this little book by Sir Frederic Kenyon have we received such lucid answers to our many questions. Eight plates, moreover, give us a clear picture of some of the manuscript sources of our Bible and its early printed editions.

Botany as an Experimental Science in Laboratory and Garden. By LILIAN J. CLARKE. (Oxford University Press. 6*s*.)

Miss Clarke's teaching of experimental botany is classic and her book is in a category by itself. All teachers should get it, not merely because it gives instructions for botanical experiments—as Professor Tansley says in the foreword, many of them are described elsewhere—but because it is an object lesson, both in scientific method and in methods of teaching.

It describes the experiments done by the girls during thirty years of Miss Clarke's work at the James Allen Girls' school. The results achieved are amazing. Seventeen successive generations of pea plants were grown in water culture only, and some of the pollination experiments give information not readily available elsewhere. The diagrams and descriptions of experiments are very clear, but it is a pity that we are not told the aspect of the laboratory and the time of year when they were tried. It is the fashion to decry heuristic methods, but undoubtedly Miss Clarke's book shows how, by using them, her girls learnt scientific method. Reference to permanent class records before drawing a conclusion made sound reasoning possible so that the pupils were made to feel that they were participating in a research and had a unity with established scientists.

The James Allen School botany gardens are well known. It is invaluable to have photographs and details of their construction and maintenance, but the greatest value of all lies in the spirit of the book. Professor Tansley regrets that Miss Clarke did not write a practical handbook for school. This is much better, for in an extraordinary way we seem to come in contact with Miss Clarke herself. Examinations would cease to be a bugbear with a teacher like this. Her book is an inspiration.

Christopher Columbus: The Tragedy of a Discoverer. By H. H. H. HOUBEN. Translated from the German by JOHN LINTON. (Routledge. 12*s*. 6*d*.)

As the greatest of all discoverers, if his achievement is measured by its results on the world, Columbus may well inspire innumerable biographers, and any book about him must be interesting if it retells the familiar story with reasonable care. Mr. Houben has handicapped himself, for some readers, by interspersing in his narrative a few imaginary conversations, as if to give colour that is hardly needed. Columbian experts will regret his acceptance of the Toscanelli letter which Vignaud demolished long ago, and of the mythical debate at Salamanca on Columbus's plan, which fills a long and tiresome chapter. Nor does the author clearly understand Columbus's vision of a wonderful country in the South Sea, somewhere to the west of Australia, which the late Cecil Jane explained so brilliantly in his edition of the *Voyages*. Still it must be said that this new life is, in the main, accurate and readable, and that it brings out the queer mysticism as well as the practical ability and courage of the great Genoese. Columbus cannot be rightly understood if we disregard the spiritual exaltation that possessed him, though not to the exclusion of a desire for worldly wealth and fame.

It was the prophet rather than the projector that impressed Queen Isabella and gained her support for the first epoch-making voyage of 1492. Mr. Houben justly stresses the care which Columbus took on that voyage to conciliate the natives. It would have been well if that example had been followed. But the men whom he left in Hispaniola in 1493 maltreated the natives and were wiped out. After that the early friendship could never be restored. Columbus's followers were rough and unruly adventurers or even criminals, and he was too much concerned with exploration to spare time for the dull task of administering the new colony. From quarrelling with the natives the Spaniards passed to mutiny, and after the third voyage Columbus was set home in chains by the fatuous Bobadilla, the royal envoy who had been sent to inquire into the situation. On the fourth and last voyage Columbus discovered South America, but was too ill and confused to understand exactly what he had done. Mr. Houben judges King Ferdinand too harshly in imputing to him a mere desire to defraud Columbus of the share of the colonial revenue which had been promised to him. Columbus's warmest admirers would hardly claim that he was an ideal governor for the new lands that he had found.

The Spanish monarchy with all its resources took years to develop a satisfactory system for the Indies. Columbus alone could never have done so. Nor is it true that the King was ungrateful. Columbus's son succeeded him as Admiral of the Indies and, with his noble wife, Maria de Toledo, reigned as Governor in Santo Domingo for nine years, though he could not exercise the absolute authority nor receive the income that had been rashly promised to his father in 1492.

Edison: His Life, his Work, his Genius. By WILLIAM ADAMS SIMONDS. (Allen and Unwin. 10*s.* 6*d.*)

Mr. Simonds, in his conscientious biography of Thomas Edison, succeeds in picturing the restless pioneer who was incessantly occupied with new inventions of the most varied kind—some most valuable and others futile. The author, in trying to follow his hero's divagations, overloads his narrative with detail of no importance, but in no other way could he give so faithful an impression of Edison's character. The inventor was hampered by lack of a scientific training, but he made up for it by a masterful personality which subjugated both his financial backers and his technical assistants and workmen to his will. He seemed often to have a very vague idea of how to attain his end, but he succeeded by sheer determination in exhausting all possible means of doing what he wanted until he had found the one right solution. It was a terribly laborious and costly method, which one cannot commend as his enthusiastic admirers are prone to do. Still, the wonder is that out of all this confused and unsystematic toiling so much that is of prime importance to our modern civilisation emerged. Edison's work in connection with the telephone, the electric lamp, the phonograph, the cinema, and the dynamo must always stand to his credit. As regards the lamp, it may be regretted that Mr. Simonds has not done justice to the English inventor, Sir Joseph Swan, who had really anticipated Edison though he unfortunately delayed to take out a patent and allowed the American to take precedence of him. The full story is clearly summarised in the memoir of Swan published six years ago* and might well have been noted by Mr. Simonds, all the more readily because Swan was quick to acknowledge the merits of Edison's perfected lamp, while the dispute over their parallel inventions was compromised by a union of interests. Nor does the biographer understand that Swan was a scientific man of real eminence, as the Royal Society and other institutions acknowledged. The most interesting pages in the book are those which describe the installation of electric lighting in New York City, a task which taxed Edison's inventive power and driving force to the uttermost since the problems to be solved were novel and complex. Colonel Crompton has told more simply in his memoirs how London was first lighted by electricity, and the contrast between the two accounts is instructive. Still, the English reader who tends to be depressed by the atmosphere of stock-jobbing and publicity that enveloped Edison must remember that, despite all this, his was a great and beneficent career.

EDWARD G. HAWKE.

* *Sir Joseph Wilson Swan, F.R.S.* By M.E.S. AND K.R.S. (Benn. 7*s.* 6*d.*)

The Social Economy of the Himalayas. By S. D. PANT. (Allen and Unwin. 15*s.*)

Dr. Pant's account of the social and economic organisation of the peoples of the Kumaon Himalayas is a welcome addition to the surprisingly scanty literature dealing with what to the social anthropologist is one of the most instructive areas of India. The influence of the strongly marked geographical environment and sharply contrasted seasonal phases of climate is to be seen in every department of the life of the people, forcing them to a semi-nomadism between summer and winter quarters in search of grazing and in the pursuit of their highly specialised form of agriculture. The author's account of the Bhotiya and other peoples of the area is based upon nearly five years' personal observation, and his record of their social and occupational activities, recreations, and religious beliefs is full of detail valuable to the student and fascinating to the general reader.

Primitive Law. By A. S. DIAMOND. (Longmans. 25*s.*)

It has long been evident that a re-examination on broad lines of the conclusions of Sir Henry Maine's *Ancient Law* in the light of later research was an urgent necessity. That book, and the treatises in which its eminent author further developed his studies of the origin and development of early law, adopted an evolutionary method which a more extended knowledge of primitive institutions has shown to be altogether too schematic and abstract. Maine's views, it must be admitted even by those who still hold the substantial validity of his chief conclusions, were too strongly coloured by the evidence of early Greece, especially as seen in the Homeric poems and the Classics, and by that of India.

In *Primitive Law* Mr. Diamond essays a constructive criticism of Maine's view that primitive law was an undifferentiated compound of religion, law, and morality. His argument is based on the material afforded by the ancient codes known to us, of which the Babylonian Code of Hammurabi and the Hebraic are perhaps the most important for his purpose, and the practice of modern so-called primitive peoples. His conclusion is that the legal code appears at a certain stage of material progress in the history of all peoples—a stage varying widely in absolute chronology, witness the interval between the Code of Hammurabi at the beginning of the second millennium B.C. and the codes of the European Middle Ages. So far, however, is it from

being the case, Mr. Diamond holds, that these codes embody a previous religious tradition, that it is possible to show by an analysis of their content that the religious element, where present, has been imposed upon a " civil " practice by priestly introductions at a later date. Even the ordeal and the deodand, which might be thought to interpose insuperable difficulties, are shown to accord with this main conclusion.

It is difficult to do justice in a brief notice to Mr. Diamond's argument and to his penetrating survey of so extensive a field of evidence. He discounts the views of anthropologists, who on the whole have tended to follow Maine ; but they might still make out a case for the religious character of primitive law, though they would now follow a different line of argument from that of the eminent jurist. While conceding to Mr. Diamond the divine character of the primitive law-giver as a product of later theology and, it may well be, at least in many instances a priestly introduction, they would rely rather on the concept of *tabu*. To some extent, no doubt, the difference may be resolved as one of the definition of " law." Be this as it may, Mr. Diamond has made a valuable and lasting contribution to a subject of great historical interest and importance.

The Cassubian Civilisation. By Fr. Lorentz, Adam Fischer, and Tadeusz Lehr-Splawinski, with a preface by Bronislaw Malinowski. (Faber & Faber. 21*s*.)

Political events in Europe during the last few years have produced much searching of heart among those who have been prone to back up dogmatic argument with an appeal to some nebulous concept, purporting to be scientific, which effectually confuses the issue. The doctrine of " race " has been much overworked in this service, until at last the anthropologist has felt constrained to come forward to expound what exactly the term connotes when used with due observance of its scientific limitations. To the lay mind it may seem that so much is whittled away in arriving at a scientific definition of " race " that the outcome is of little practical value in the approach to international or national problems. Therein it is probable that the lay mind is right.

As an aid towards clear thinking Professor Malinowski tenders certain suggestions in his introduction to this volume. Apart from the question of " race " in the biological sense, he points out, a distinction can be drawn between political allegiance and cultural loyalties—a distinction to which the history of his own land of Poland gives peculiar force, and also one which it is essential to keep in mind in dealing with the people of whom this volume is a study. It is unnecessary to say more than that the Cassubians inhabit the Polish Corridor, to indicate the bearing of his observation.

The Cassubians are an ancient and peculiar tribe who live on the seashore on both sides of the German-Polish frontier line. Their culture is here submitted to a detailed analysis from the historical point of view by Dr. Lorentz and in reference to its ethnologic affinities by Dr. Fischer ; while the evidence of linguistics on their cultural origins is evaluated by Dr. Splawinski. The conclusions of these three lines of enquiry converge in the general proposition that notwithstanding the absorption of certain German elements, the Cassubians in all essentials are Slavonic, and their culture identical with that of the Poles.

This is an extremely interesting conclusion upon which it is unnecessary to enlarge here, except to emphasise the fact that the investigation has been carried out by each of the authors in his special province in a spirit of scientific impartiality. Apart from its immediate practical bearing upon a delicate point of current discussion, the volume is an important contribution to the study of European folk-culture which ethnologists will appreciate at its true worth.

Both Sides of Buka Passage. By Beatrice Blackwood. (Oxford University Press. 35*s*.)

It is becoming increasingly difficult for the would-be student at first hand of " primitive " manners and customs to find a corner of the world in which the natives have not been profoundly affected by European contacts. The recent expedition of the Oxford Exploration Club to the New Hebrides found that on the coast the natives had completely abandoned their culture ; and it was only by penetrating the bush that they were able to get into touch with savage life more or less intact. Miss Blackwood's experience in the Solomons was similar. She began work on Buka Island, but was constrained to cross the narrow Buka Passage to the opposite coast of Bougainville, the most northerly of the Solomon Islands, where the unsuitability of the soil for plantation had saved the natives from sophistication. Under the rule of the Mandated Territory of New Guinea, they are allowed to pursue their own devices, except for the all important reservation of the death penalty and the institution of a headman.

Miss Blackwood's investigations were undertaken under the auspices of an American Board for research on the problems of sex. The sexual life of the natives of Buka Passage follows what must be regarded as a normal course in a primitive society in which early betrothal and polygyny prevail. It is interesting to note that marriage by purchase is practised and recognised as such. Though anthropologists have shown an inclination to doubt its existence in simple societies, the fact among the peoples observed by Miss Blackwood is incontestable. What may be termed " romantic love " appears, as might be expected in these conditions, only in irregular relations and unions which have originated in this way.

It is fortunate that Miss Blackwood has been able to observe these peoples before their culture deteriorated. She has interpreted the scope of her enquiry liberally and has given a detailed account of the life of the individual and his cultural background, his social organisation and religious beliefs, which is of permanent interest and of high scientific value, even when connection with the relations of the sexes is remote.

Naskapi : the Savage Hunters of the Labrador Peninsula. By Frank G. Speck. (University of Oklahoma Press. $3.50)

The Naskapi-Montagnais Indians of Labrador, as described by Mr. Speck, are certainly among the most interesting of the American aborigines in the northern half of the continent. It is remarkable that they should have received so little attention from the anthropologist. Although they have been in contact with Europeans forms of thought through the early French missionaries for nearly three hundred years, Christianity, to the tenets of which they readily subscribe, has left their fundamental habit of belief untouched. As a hunting people they cling to the mystic relation with the animal world upon which, according to their conception, their success in hunting and, therefore, their very existence depend.

Mr. Speck's account of the mode of existence of these people indicates clearly the strenuous conditions imposed on them by

the character of their geographical and climatic environment. Living as they do, and have done for generations, in a delicately balanced adjustment, it needs but the slightest disturbance to precipitate them into starvation. They afford an instructive example of the conservatism which has acted as a protective force to preserve their culture undisturbed long after equilibrium between mode of life and environment had been established. They show little signs of progress from the stage they must have attained when they settled down after their migration into eastern America. Hence the interest of their animal cults, especially those of the caribou and the beaver, while that of the bear presents a strong resemblance to the cult of that animal which has been recorded among the peoples of N.E. Asia.

A Hundred Years of Anthropology. By T. K. Penniman. (Duckworth. 15*s.*)

Mr. Penniman, happily, has transcended the limitations of his title and of the series of which the volume forms a part. He has given his readers a complete history of the science of man from its beginnings. These he takes to be the enquiries of Herodotus, the "Father of History," who might indeed with equal justice be styled the "father" of anthropology. If that be so, then Charles Darwin, as Mr. Penniman shows, surely becomes the intellectual midwife who brought the science to a second birth in modern times by giving it form and unity of outlook.

The history of anthropological studies in Mr. Penniman's view falls into four periods. A formulary period when the elements of the science are scattered through all the other sciences, extending from the beginnings up to 1835; a convergent period when efforts are being made to relate the various enquiries that bear on man, ending with the publication of *The Origin of Species* in 1859; a constructive period, ending in 1900, in which the influence of biological principles is paramount—a period marked by the integration of biological and cultural studies; and finally a critical period extending to the present day, in which the scope of anthropological studies is much extended and at the same time the extended employment of mendelian and biometric principles induces a more critical attitude towards the methods of enquiry and its results.

Within these divisions of his subject matter Mr. Penniman's treatment is both broad and thorough—in fact, it may seem to some that he has cast his net too widely. If that be a fault, it is on the right side. He has brought together a vast amount of useful material which is so arranged and handled as to give a lucid exposition of the developments of anthropological thought, not merely within the four corners of the science itself, but also in the relation of the anthropological point of view to the development of ideas in philosophy and politics.

Unsolved Problems of Science. By A. W. Haslett. (Bell. 7*s.* 6*d.*)

There is only one inaccuracy in Mr. Haslett's fascinating, splendidly written and essentially sound *catalogue raisonné* of the loose ends which science hopes to pick up some day: its title. Thirteen unsolved problems, or rather groups of unsolved problems, are listed, ranging from those concerning the creation of the universe and the existence of other worlds than ours to the structure of the atom, from macrophysics and astronomy *via* biology ("Is Man a Machine?" and "The Riddle of Sex") back to physical science again, represented at the far end by those microphysical inquiries into which chemistry is now being absorbed. What is left out entirely is psychology. Whatever his reasons for this omission—and half a dozen such reasons are conceivable—the author might have done better to call his book *Some Unsolved Problems of Science*, thus avoiding that suggestion of completeness which he certainly did not intend. Be that as it may, it is certain that the unsolved problems included in the list are expounded with an adequacy and a lucidity that leave nothing to be desired from the point of view of the non-scientist yet scientifically interested reader.

As to the one important omission, it might be stated that psychology differs from all other branches of science in this: while these other branches have each formulated a clear, coherent and unequivocal set of questions which must be answered—even if at this stage more than one answer seems possible to some questions—psychology has, as yet, not succeeded in agreeing on the right technique of asking its questions. Other sciences *have* their problems; psychology, beside having problems, *is* a problem, even to itself. Yet in a scheme of sciences as a coherent account of "the world as nature" in the Baconian sense psychology has not only a definite but also a vastly important place: its business is to account, in causal terms, for those regions of being which cannot be reduced to cause-effect sequences in the sense of physics; in other words, to enrol the realms of the supernatural, of ends and values, into the scheme of nature as being comprised of fictitious, "merely imagined" entities. It is significant that to-day when physics is worrying itself into a kind of metaphysics chiefly because of the irresponsible behaviour of the smallest particles, when, in the words of Mr. Haslett, "even when dealing with the atom the personal factor cannot be left out," psychology tends to preserve the mechanistic outlook of the last century in its purest form.

To one reader at least who is interested not so much in the special sciences as in the philosophical foundation and background of all science, two further reflections are suggested by Mr. Haslett's excellent book. The first is closely attached to the one just referred to: that when we reach the borderland of nature, as both in largest-scale and smallest-scale physics, science tends to be left with the test of coherence as its sole criterium of truth, and that thus a mode of knowing which started out by limiting "reality" to "facts" is being driven by its inner logic to reverse its original position and to conclude that we cannot know facts, but only interpretations, *i.e.*, ideas. The other reflection is that the proposition that problems now unsolved will some day be solved by the methods and on the basic assumptions of science is *apparently* a bit of induction, and like all induction expresses the pious hope that nature's uniformity will not leave the scientist in the lurch. That is to say, while this proposition may be supported by inductive reasoning it originated as an *a priori* decision, "the determination," to speak with H. Gompers, "to employ all means in accounting for all facts as being causally conditioned, and, whenever the attempt to establish the causal context of a given fact fails, to regard this failure not as a refutation of the causal law but as proof of the presence of an unsolved problem." What lies behind Mr. Haslett's catalogue of unsolved problems—as behind any such catalogue drawn up by a scientist—is precisely this determination: that act of faith which launched the scientific movement on its career of triumphs.

Eugene Bagger.